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Two Letters

When saddled with business troubles, it is just as well to ascertain how others, likely to be similarly placed, are faring. Thus, as our foundry industry is distinctly worried about the core oil, and particularly the linseed oil, shortage, we wired friends in France and Belgium to see how they were placed. From Paris we received the following:—

" In France, linseed oil is allocated to the various industries through the ' Office Central de Répartition des Produits Industriels, Section de la Chemie.' Allocations are made quarterly according to the needs of the following period; this precludes the possibility of individual accumulation of stocks, except for a small amount to ensure carrying on in case of a short delay in delivery.

" The last quarter was outstanding (*marqué*) because of a real (*sensible*) increase over all earlier ones, and it is generally thought that this increase will continue. Yet, the allocation which should have been made at the beginning of July has not yet been carried out, no deliveries having yet been recorded. The small stocks in the works have since been used up, and this cessation of consumption has coincided with the closing of the works for the holiday period with pay.

" For the restart, the small stock conserved by the allocating body will be distributed according to order of priority, in which the foundry industry is almost at the top. Certain industries, such as the paint trade, will not get any allocation. By gathering in all possible supplies, including the proverbial scrapings from the bottom of the barrel, the quantity of oil allowed by priority to the foundry industry for the current quarter amounts to a maximum of 25 per cent. above the previous allocation. The situation is thus very critical, but it is hoped to receive, in the near future, a certain tonnage of linseed, which will reduce somewhat the existing scarcity.

" As for other binders, the French production of sulphite lye is reduced because of the shortage of coal, but this is somewhat discounted by the ample supply of dextrine, as the potato harvest was heavy. On the other hand, no hope is held out for the supply of other nationally-produced vegetable oils, the latter being produced in small quantities for foodstuffs, of which they form the chief reserve.

" Taken altogether, the French foundry industry is entering once again into a period of restriction which is adverse to national rehabilitation and technical progress. All national sources capable of yielding satisfactory bonding agents were thoroughly examined during the hard years of the occupation."

Belgium seems to be quite well placed, and is obviously worth a flying visit by officials of the Ministries of Food and Supply, and the Board of Trade.

From Liège, our correspondent writes:—

" I made immediate enquiries and have received from various quarters confirmation that the Belgian market is well provided for with linseed oils and ancillary products; in fact the market here seems to be flooded with these products which are being offered right and left."

THE COUNCIL OF IRONFOUNDRY ASSOCIATIONS announce that the labour force in May, for the ironfounding section of the industry, amounted to 117,591, which included 9,246 female workers. The increase since October 1, 1945, was 19,094 employees.

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BOOK REVIEWS

Proceedings of the Institute of British Foundrymen, Vol. XXXVIII, edited by John Bolton, acting secretary, and published by the Institute from St. John Street Chambers, Deansgate, Manchester, 3.

A standard of high technical worth has been achieved in this volume, which it will be difficult to maintain in the future. Learned societies are just like vineyards, and are dependent on factors beyond the control of the direction for the quality of the ultimate product. There was the spice of novelty of approach in the majority of the Papers presented at the 1945 annual general meeting. Normally, any novelty appears amongst the results achieved from an orthodox research. Novelty of approach was shown at its best both by Mr. S. L. Fry in his Paper "Preliminary Investigation of Metal Pouring by Ciné. Photography," and by Mr. N. E. Rambush and Mr. G. B. Taylor in their study of "A New Method of Investigating the Behaviour of Charge Material in an Ironfoundry Cupola and Some Results Obtained."

Another noteworthy feature of this volume is the very high percentage of space devoted to non-ferrous subjects. There are no fewer than 10 Papers which are predominantly non-ferrous in character; five are of general interest (sands and the like); four cover grey iron; and three each for malleable and steel. This should encourage the non-ferrous foundrymen to assume greater responsibility in the conduct of the Institute's affairs.

This volume has been well worth waiting for, its lateness in publication being due to difficulties in the bookbinding trade.

The Works' Technical Information Service, by R. Howard. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 1s. 6d. net.

For those very large firms which can afford the services of an expert library staff, and have the necessary accommodation, the information given in this booklet will serve as an excellent revision course. For smaller concerns, reliance can usually be placed on their appropriate research organisations. As the author points out, there are 3,000 articles and Papers published annually on engineering subjects, and their reading, digesting and abstracting is far too much for most concerns, and in any case would, if largely duplicated, be a national waste of a good type of cerebral energy. Co-operation is the obvious solution.

V. C. F.

The Law of Trade Unions, by H. Samuels, M.A., Barrister-at-Law (Second Edition). Published by Stevens & Sons, Limited, 119-120, Chancery Lane, London, W.C.2. Price 6s. net.

As the first edition of this book was reviewed in our issue of February 14, and as no major additions or alterations have been made, there is little that can be said except once again to stress its usefulness to those whose duty it is either to operate or negotiate with trade unions.

Pressure Gauges—Their Installation and Repair, by J. R. Fawcett, B.Sc. Published by Emmott & Company, Limited, 31, King Street West, Manchester, 3. Price 1s. net.

Most foundries have pyrometers which they calibrate periodically. They also possess pressure gauges, which are normally taken for granted. Thus the reviewer welcomes the publication of this little book as being a cheap and welcome addition to technical literature.

V. C. F.

FUTURE OF THE STEEL INDUSTRY

Included in the statement issued by the Ministry of Supply on Tuesday, was the following:

As announced in the House of Commons on April 17, the Government have decided to appoint a Board to be responsible to the Minister of Supply for the general control and supervision of the iron and steel industry. The Government have now decided that the Board should concentrate, under the Minister, on the supervision of the development and reconstruction of the industry and on the exercise of such continued direct control functions as may be necessary in such matters as production, distribution, and prices. It will not, however, be part of the functions of the Board or of the members from the steel industry to advise the Government in connection with plans for public ownership. The preparation of such plans, with a view to the submission of proposals to Parliament, will be treated by the Government as a separate matter.

The British Iron and Steel Federation has intimated that the industry will associate itself with membership of the Board on this basis, and will press on with the modernisation programme with all possible speed. Accordingly, the Minister of Supply is proceeding with the selection and appointment of members of the Board, including men with direct managerial experience of the industry. The names of the members will be announced shortly.

BRITISH INDUSTRIES FAIR

The first British Industries Fair since 1939 is to be held from May 5 to 16 next year, at Earls Court and Olympia, London, and at Castle Bromwich, Birmingham. As in pre-war years, exhibits will be grouped in two main sections. The lighter industries in London, and the engineering and hardware at Birmingham. The London section of the fair is organised by the Export Promotions Department, Board of Trade, 35, Old Queen Street, London, S.W.1, and the engineering and hardware section by the Birmingham Chamber of Commerce, 95, New Street, Birmingham, 2.

Special attention will be devoted to the display of United Kingdom products suitable for export and it is hoped the fair will attract many buyers from abroad as well as buyers in Britain. Application forms for space have been sent out to United Kingdom manufacturers.

SYNTHETIC SAND PRACTICE*

Special problems of the South African foundry industry are discussed

By J. J. MARAIS, B.Sc.

[SLIGHTLY ABRIDGED]

Sand control has as yet not taken a firm hold in the South African foundry industry; but it will most certainly do so in the near future, as everybody is becoming sand conscious, realising the necessity of minimising one of the greatest variables in the foundry industry. One finds that the more one studies this most interesting subject the more is one likely to get lost in a maze of claims. The experience of others naturally helps a great deal, but no foundry will be able to rectify immediately all its defects by merely using sand testing equipment and converting to synthetic practice.

All changes must be made gradually and all results recorded. If, for example, trouble is experienced in the casting of a certain job, nothing will be learnt by changing a number of variables all at the same time. If by chance one happens to obtain a good casting, one cannot explain why it so happened.

Sand testing must be done systematically, all results being recorded. It is a good idea to draw a graph indicating the daily variation in the physical properties of the sand. For example, variations in permeability, strength green and dry, moisture, etc., should be recorded; and, if possible, these results should be correlated against casting losses due to sand defects.

Sand Testing No Panacea

One must also realise that certain defects that may result are often attributed to the sand, when something else is really at fault. The cause may be wrong or neglectful gating and rising, moulding, venting, designing, pouring, speed and temperature, bad metal, or a vast multitude of other causes, too many to name here. For instance, in a certain foundry, trouble was experienced in the form of small marks and holes which appeared just above the ingate on a certain casting. This everybody attributed to a wash of the sand, but on closer investigation it was soon apparent that the metal was dirty. No more trouble was experienced after incorporating a skim gate in the runner.

Even an inadequate supply of compressed air on the moulding machines may cause trouble if the pressure suddenly drops when all machines are operated together. Naturally, ramming will then not be effectively accomplished. Another cure may be cited, where a vast amount of trouble was experienced with a certain casting which contained a thin core practically surrounded by metal. Every conceivable sand mixture was tried for the making of this core, but if the core did not break during casting, then it "blew." Nothing seemed to cure the trouble. Eventually the core-maker was replaced by another and the trouble automatically disappeared.

In many foundries moulds are being cast without adequate care being taken to see that the moulds, runners and gates are free from loose sand and dirt; some individuals are actually of the opinion that this cleaning procedure takes up too much time. There are numerous other cases worthwhile mentioning, but space does not permit. Often "off metal" is to blame, but this is really a separate subject. The main point is that there are so many variables in the making of even a simple casting that it is often difficult to diagnose the fault. More often than not the sand gets more than its fair share of the blame, when some other defect is really at fault.

Definition of a Synthetic Sand

According to the American Foundrymen's Association, the definition of a synthetic sand is a sand compounded from selected individual materials which, when mixed together, produce a mixture of the proper physical properties from which to make foundry moulds. In his book "Foundry Sands," Walker gives the following definition: "A synthetic sand is made up by milling together a silica sand and a clay. In such a mixture a silica sand is selected in which the grains have the size, shape and surface desired, whilst a clay can be chosen of which the binding power, refractoriness and temperature of dehydration are considered suitable for castings to be made."

According to the sceptic, a synthetic sand is just what the name implies. Quoting the dictionary, the meaning of the word synthetic is "the artificial production of compounds." In other words, a substitute. The sceptic's view of a synthetic sand is, therefore, a sand to be used as a substitute, only when a good natural sand is not near at hand or available. But he loses sight of the fact that good natural sands, more particularly for high temperature work, are neither abundant nor are they widely distributed anywhere. Nature very seldom deposits any minerals uniformly, and ready for use without any further treatment. For example, the current of water which is able to transport sand and clay is unlikely to drop both simultaneously, because as the velocity of the stream is checked the sand is more likely to separate out first, carrying a certain percentage of heavy impurities with it. The clay will only separate out later on. Thus, it is obvious that by bringing together a silica sand from which all impurities have been removed, and which has been specially graded by artificial means, and a clay in the most desirable proportions, the ideal sand is more nearly achieved. A good moulder may still be able to make a good mould from indifferent material, but the machine cannot readily react to wide variations in the condition of materials.

To prove that a synthetic sand is to-day not a substitute but a necessity, the following case is cited:—

*A Paper read before the South African branch of the Institute of British Foundrymen, Mr. Holdsworth presiding.

Synthetic Sand Practice

In a highly mechanised South African foundry approximately 35 tons of sand circulate at the rate of 20 tons per hour. Castings are produced weighing 50 lb. each—two in a box. The sand to metal ratio is approximately 2 to 1. This casting rate is continued for 20 hrs. per day, and during that period 70 to 90 tons of metal are cast. This has been done for the last 5 or 6 months, and the permeability of the sand during that period increased slightly instead of decreasing, although the only new sand added was a small amount to replace that sticking to the casting. It must also be borne in mind that the sand becomes seriously heated due to its fast circulation. Will one ever be able to perform this feat in a natural sand? The natural sand will soon collapse and will only be rejuvenated by the addition of sand very high in clay grade substance. On introducing a sand of this type, however, a large percentage of silt will soon accumulate in the sand and clog it up to such an extent that blows in the casting will soon appear. Furthermore, due to the high temperature of the sand, the natural sand will not bond it sufficiently and difficulties in moulding will become more apparent due to too low green strength.

In another instance, a steelfoundry has decreased its sand consumption to at least one eighth of what it was using previously by switching over to synthetic sand. (This figure could be further reduced if a proper sand conditioning plant was available.) No longer are new facing sands required for each casting, and in addition the finish has improved considerably. It was even remarked that the castings resembled iron castings.

In one General Motors plant in America, 450 tons of sand, with an addition of 7 tons of clay, circulated through the three conditioning plants every hour. Imagine this plant operating on a natural sand. The amount of natural sand added to the system would be tremendous. Assuming that a natural sand carrying 20 per cent. clay grade substance was added, it would be safe to state that only one half of this amount of clay grade substance would be true clay. Even if this clay carried in the sand is as good as the clay actually added, it would take 70 tons of sand to be added each hour. This would certainly cause numerous difficulties and expense in sand handling.

Choice of Base Sand and Clay

Before choosing a base sand, the most important point to consider is to make absolutely sure that the sand will give the correct permeability for the job it is supposed to do. The following figures may act as an approximate guide:

Aluminium and brass ...	Permeability	7 to 20
	Fineness No.	225 „ 120
Light grey iron	Permeability	15 „ 25
	Fineness No.	120 „ 90
Medium grey iron	Permeability	45 „ 60
	Fineness No.	80 „ 70
Heavy grey iron (green sand)	Permeability	80 „ 120
	Fineness No.	60 „ 50
Heavy grey iron (dry sand)	Permeability	55 „ 85
	Fineness No.	75 „ 65
Light steel castings (green sand)	Permeability	90 „ 150
	Fineness No.	56 „ 48
Heavy steel castings (green sand)	Permeability	120 „ 250
	Fineness No.	55 „ 38
Heavy steel (dry sand) ...	Permeability	100 „ 200
	Fineness No.	60 „ 45

The fineness number depends greatly on the distribution. A sand of high fineness number, if evenly distributed, will give an equivalent permeability to a sand of low fineness number that is distributed. Once a sand has been chosen to give the correct permeability required, it is necessary for different consignments of the same sand to be uniform in properties. Successive consignments when treated in exactly the same way should give the same results. Foundries having no sand testing equipment must rely on the supplying firms to carry out sufficient testing to be able to supply specified sands having the approved properties. Natural occurring sand deposits usually vary in their properties. This variation can only be overcome by artificially grading the material. However, it is now known that a certain small percentage of fines are desirable, as too uniform a sand has a tendency to pack too evenly leaving no room for expansion of the individual silica grains, but this percentage of fines in the sand must remain consistently the same. The present trend is, therefore, to procure a sand where the bulk of the material lies on three adjacent sieves with a few per cent. on the other screens. The distribution will thus be such as to lower the expansion.

The main point to consider in order to obtain a smooth finish is that the finest sand possible must be used to give the required permeability, and this can only be done by using a sand of even distribution. True, a smooth finish may also be obtained by the excessive addition of facing materials, but this point will be discussed later.

Sand Distribution

The distribution of sand is one of the most important points to consider. Once the distribution of a sand is upset it certainly takes time to recover it again. The distribution of the base sand is often deliberately destroyed by the addition of a small quantity of coarse material. This is usually done with the idea that the sand is being "opened up"; but at least 30 per cent. of coarse material will be necessary before it will affect the permeability in any way. What may occur is that the expansion and contraction of the sand will be influenced, but certainly not the permeability. To illustrate, if one mixed a bag of ball bearings and a bag of sand together, the ball bearings would certainly not influence the permeability of the fine sand.

In order not to disturb the distribution of the sand, therefore, it is always wise to select a core sand, where-

ever possible, of the same grain as the moulding sand, so that it can be knocked out with the moulding sand and bonded up as such. Burnt core sand makes an excellent moulding sand if bonded with a good clay, because the grain is roughened and holds the bonding clay more tenaciously. The "make up" sand entering the system can thus be done *via* the core sand, provided sufficient core sand can enter the system to make up for lost sand.

Resultant Properties

There are many other factors to influence the finish on a casting. If, for example, a sand has low flowability it will not pack well against the vertical faces of the mould, due to the inter-granular friction between the grains which produces a rough finish on the vertical faces. On the other hand, a sand of high flowability invariably has a high expansion value and will therefore pack so well on the horizontal faces (being in direct line with the ramming force) that, due to the high expansion accentuated by the terrific heat on to the cope, the expansion may cause a break in the sand and result in a "rat tail," "buckle" or "dummy scab." The addition of a cereal binder to the sand reduces the flowability and usually cures the above defects on the cope side of the casting.

Theoretically speaking, what is actually required is a sand of high flowability for the vertical sides of the mould and one of lower flowability for the top. In natural sand practice one has to rely solely on the skill of the moulder to fulfil all these conditions by careful ramming, because it is difficult to change the strength of the sand to suit all jobs. Synthetic sand practice is much more flexible. The strength as well as the flowability of the sand can be varied by the extra addition of clays, cereal binders, fines, etc. For example, if the casting being made has a large horizontal face the flowability can easily be lowered at will. Generally speaking, synthetic sand has higher flowability values than natural sands. Flowability, by the way, can be defined as the ease with which the sand can be rammed not necessarily in line with the ramming force.

Glass and Iron Ore Additions

Another important point to consider as far as the base sand is concerned is the refractoriness of the sand. It is well known that impurities, small percentages of lime, magnesia, iron oxide, etc.—lower the sintering point of the sand appreciably. Sand that is not refractory enough will burn on the casting, leaving a rough finish, thereby increasing fettling costs by at least 50 per cent. The addition of one per cent. of fine powdered glass to a pure silica sand reduces the sintering point from 1,425 to 1,400 deg. C. The object of this addition to the sand used for steel was to form a highly viscous film between the sand-metal interface that would resist the steel from penetrating the sand and locking it to the casting. Thus on annealing this thin film of material would easily peal off and leave the casting clean and smooth. The results, however, were not very satisfactory, the glaze being more or less localised due to the glass not being distributed evenly enough. Recent literature has been published recommending the use of small percentages of iron oxide to act in a more or less similar manner.

The fineness of the sand also influences the sintering point, fine grains sintering at a lower temperature than bigger grains. It is always wise, therefore, in the case of steel castings, to paint the mould with an evenly grained fine silica wash,* in dry sand moulding. This wash will sinter evenly, preventing the sand from locking to the casting. In green sand moulding, an evenly grained sand must be used so that sintering occurs simultaneously.

Sintering Influences

Controlling the mould condition requires consideration of a number of distinctive factors, namely:—time, temperature, chemical and physical properties and concentration of impurities. As is well known any chemical reaction takes time to be completed. The rate of reaction is greatly influenced by the temperature and the concentration of reactants. Thus, the higher the temperature and the bigger the concentration of impurities in the moulding medium the greater will be the number of chemical reactions forming new ceramic compositions on the face of the mould during the pouring and cooling time of the casting. According to Dietert, as the green compression increases from 2.0 lb. per sq. in. to 7.0 lb. per sq. in., the sintering temperatures decreases from 1,493 to 1,360 deg. C. In other words as the concentration of clay in the sand increases, so the sintering temperature decreases.

Permeability is always relative to the amount of gas generated. The molten and cooling metal in the mould is retained not only by the moulding material but by a retaining envelope of hot gas under pressure. In order to obtain a smooth finish one can go from one extreme to the other. One could use an open sand containing a large proportion of facing material, which evolves a large volume of gas fairly rapidly, and then rely on the gas pressure exerted at the mould metal interface to give the required finish, or one could use a "close" sand containing less facing material and rely more on the moulding material to produce the finish required.

In steel moulding, particularly, the nature of the gas evolved has a great bearing on the final result. A reducing or neutral atmosphere assists in giving a smooth finish. If an oxidising gas (for example, water vapour or air) is present in large quantities, this gas will form a film of iron oxide on the metal surface. The iron oxide in turn will react with the silica to form iron silicate, which adheres to the casting. A natural sand always carries more water than a synthetic sand, and this is one of the chief reasons why a natural sand burns on to a steel casting to a greater degree than a synthetic. Naturally, the low sintering temperature of a natural sand also assists in increasing the burn-on effect.

Facing Sands

The following facing materials are usually used for cast iron:—coal dust, pitch, and fuel oil. Pitch and fuel oil both have the disadvantage that because of

*Not now considered desirable.—EDITOR.

Synthetic Sand Practice

their high volatile content they must be very strictly controlled. Moreover, on being used for some considerable time they seem to form a waterproof coating round each grain, with the result that it becomes difficult to add tempering water to the sand. Pitch has a further disadvantage in that it forms a lumpy sand on shake out and this often requires extensive milling before it is broken up completely. It is also difficult to store pitch in powdered form as it soon congeals in solid lumps in the bags. Coal dust has a disadvantage in that if the ash content is high in alkalies it will gradually reduce the sintering temperature of the sand, but provided a specially selected coal dust is used, running low in ash content and high in volatile matter, this difficulty never causes serious trouble.

Steel Sands

In steel sands the following facing materials are usually used: cereal binders, molasses, oils. Molasses is recommended for use in South Africa, being the cheapest of the three. Both cereal and molasses reduce the flowability of the sand and will thus give a clean casting on the cope side. They also prevent the sand from washing—steel having a greater tendency to wash than iron—and help to produce a neutral or reducing atmosphere in the mould. Oil does only the latter.

Bentonitic Series

For bonding purposes, special clays must be used, as these clays should not only have high green strength, but must have durability, a high sintering point, ability to mix rapidly, adequate strength at high temperature. They must not form hard lumps in the shake out sand, and must develop high dry strength when necessary. The three main types of bonding clays in the foundry are kaolinite, illite and montmorillonite. There is just as great a difference in value between the good and poor clays of each class as there is between the classes themselves. There is still considerable speculation as to the reason for the different results given by different clays. According to N. J. Dunbeck, however, the most important single factor in determining results is the mineral composition of the clay.

Kaolinite Clay.—Under this heading are grouped practically all the refractory clays, such as fire and ball clay. The best of these clays gives moderate green strength, fairly high dry strength, excellent durability, and the highest sintering point. It is used extensively in heavy work, and often in conjunction with montmorillonite, since a combination of these two clays give very high hot strength.

Illite Clays.—The writer does not profess to know much about this type of clay, but according to several overseas experts many natural bonded sands contain illite as a major constituent of their clay content. These clays develop slightly higher green strength than the kaolinite type, but have lower dry strengths and durability.

Montmorillonite Clays.—These clays can be subdivided into two groups—those that swell by the addition of water, and the non-swelling type. The non-swelling type gives higher green strength than the swelling type, but has lower durability and lower hot and dry strengths. Both types have much higher green strength than the kaolinite or illite types, but are lower in durability than the kaolinite.

From the above, it is clear that a clay cannot be evaluated on its green strength alone. Other factors, of which durability is of special importance, must also be taken into consideration.

Sand Preparation and Control

The sand in the foundry should not be regarded as a heap of dirt, but should come under strict supervision and control. In order to obtain the maximum efficiency, the sand must be kept clean and in proper condition by:—(1) Mixing thoroughly, the method of mixing depending on the type of foundry; (2) removing all the metal either by means of a magnetic pulley or by screening; (3) keeping the sand as cool as possible; (4) controlled desilting; (5) aerating after mixing; (6) most important of all, controlling it by regular testing.

Advantages of Synthetic Sand

(1) Synthetic sands have higher durability than natural sands.

(2) Synthetic sands are more refractory, because of their purity. This results in a much better peel and lower cleaning costs.

(3) Silica sands are always uniform when washed and graded. Since the foundryman is making a definite mix to suit his own conditions, he has something standard from which to start.

(4) Sand handling costs are reduced, since the total amount of sand handled will be reduced considerably.

(5) Once control has been established, it is easy to maintain. A sharp reduction in scrap losses will therefore result.

(6) Due to their flexibility, strength, flowability, etc., synthetic sands can be varied at will, thus promoting a clean draw from the pattern which results in increased production.

Disadvantages of Synthetic Sand

(1) Synthetic sands dry out faster due to higher permeability.

(2) They are more difficult to patch.

(3) They are workable over a narrower moisture range than natural sands.

(4) To handle synthetic sands properly, more extensive mechanical equipment is required than is necessary for natural sands.

In conclusion, the writer again wishes to stress the point that it is high time for planned research in the foundry industry to be inaugurated in South Africa. The day where every foundry carried its own little black bag of magic and adhered to its own rule of thumb methods is past. Moulders must compete with the overseas markets, but they can only do so if they have an efficient industry built on adequate and controlled research.

At the same time, it must be realised that research in the foundry, where one has to contend with so many

variables, is no easy matter. It will require men who are proficient in the art as well as the practice of moulding. Everybody pays for research as it is, but at present it is done through casting losses amounting to thousands of pounds annually. Why not rather spend this money on something more constructive? South Africans are riding on the research or experience (if they ride at all) of the men overseas, and this is certainly not a safe nor a progressive business policy. Research men are making the machines that save the labour of men and promote their safety and material happiness. Shall users then go on in the dark and merely grub amid sand and hot metal?

The Author wishes to thank G. & W. Industrial & Chemical Supplies (Pty.), Limited, for allowing him to read this Paper, and also all those friends who have so kindly assisted him.

DISCUSSION

The president, MR. H. HOLDSWORTH, welcomed Major J. Robertson, who had been absent on active service for several years, and Mr. D. C. Paterson, of Paterson, Hughes Engineering Company, Limited, a member of the London branch council of the Institute.

MR. TEUBES in proposing a vote of thanks to Mr. Marais, as one of the pioneers of synthetic sands, said his firm had carried out a considerable amount of hard work groping in the dark. It was only now that the foundry industry were beginning to build up information as to the capabilities of local sands. He was pleased to see that many foundries were beginning to see the advantages of synthetic sand.

Replying to a question from Mr. Hepple, MR. MARAIS said that synthetic sand containing a clay bond was not very successful for steel castings. It should have a small percentage of molasses or a cereal binder. His statement regarding the same sand being used in one foundry for 15 days referred to an ironfoundry.

Tensile Tests

MR. WARD asked whether Mr. Marais considered that sufficient attention in sand testing had been given to tensile strength. In general, there had been tests for compression, permeability and moisture. He was referring particularly to drawability, in which connection he suggested that green tensile was of vital importance.

Although he had never personally conducted tensile tests, MR. MARAIS thought that green compression and tensile strength were relative to one another. The deformation of the sand, however, would also have to be taken into consideration. The tensile strength should actually give an excellent indication as to whether a sand would draw deep or not.

MR. WARD then stated that in his experience sands of equal compression strength might possess vastly different properties as far as "drawability" was concerned. He was actually fitting a tensile tester to his compression machine.

MR. MARAIS mentioned that there was a factor known as "resilience" which was calculated by multiplying the deformation reading by the compression, and which indicated the amount of work required to break the sand. He thought that was what Mr. Ward was after. He then referred to an instance he had come across recently where a foundry was making a green sand job of a thin section to be cast and the metal fell directly on to the green sand core, the sand tending to wash. Had the sand been slightly more resilient, he believed that it might not have washed so much. It was too brittle and not sufficiently tacky.

MR. WATTS pointed out that where metal was dropping directly on to a core of thin section, washing could be overcome by placing a thin metal plate at the bottom.

MR. MARAIS said that this had been unsuccessfully tried. A further consideration was that the job had to be enamelled afterwards and the metal plate would stick to the casting. In his opinion, the best method to overcome the difficulty was by altering the clay or perhaps by spraying the green sand core with molasses water.

Coal Dust

The PRESIDENT said he was interested by the increasing tendency to use synthetic sands, which embraced the subject of coal dust, pitch or oil. In the early days of the branch he had brought up the subject of coal dust. Scepticism was then expressed regarding its capabilities. In view of the amount now used the general attitude had evidently changed. Coal dust had become standard equipment in every foundry. It would be the same with synthetic sand.

Referring to the coring of the stove casting on view, Mr. Marais had said that it could not have been cast had oil been used. He disagreed, stating that overseas he had seen castings innumerable for water jackets made from oil sands.

MR. WATTS related that two weeks previously he had experienced trouble using synthetic sand with an oil bond. He had added about 0.5 bentonite plus oil as binder. The sand was Barclay Bridge sand. The job in question was an impeller, the thickness being about 5/16 in. No trouble had previously been experienced with oil synthetic sands. A new core-maker was taken on and constant trouble was experienced with the impellers blowing. At first they blamed the venting, but eventually they decided that it was due to the hardness of the ramming. After that had been altered no more trouble was experienced.

MR. MARAIS then gave an instance of some cast phosphor-bronze bushes, which were in such a condition that it was impossible to extract the cores due to metal penetration of the core sand. Eventually the core sand was changed and a core was rammed, which strangely enough came out clean, though basically there was no difference in the sand at all. The mixture was then changed and all the cores came out satisfactorily. Eventually, however, they reverted to the old sand mixture and the cores were still satisfactory.

A MEMBER expressed the opinion that it was fatal to add natural sand to green sand, hoping to give it green strength. It was much better to add a colloidal clay and so obtain maximum permeability.

The PRESIDENT said that it was due to oil sands that motors could be so easily made to-day. Sea sand and oil sand cores were the reason why cylinders were now

Synthetic Sand Practice

so good. He was thinking particularly of a 5 h.p. gas engine cylinder, for which the core carrier had been developed on lines such as to give it a good backing to hold it in position when it dried.

MR. DE KIEWIT agreed that oil sand cores could be used favourably provided conditions were such that the core could be supported. Otherwise, sand of high green strength would have to be used: it would then not be possible to use a core blower.

MR. MARAIS explained that as the green strength increased, the percentage of oil must also be increased in order to obtain sufficient dry strength. This extra percentage of oil might cause blowing. For that reason in the case of that particular stove core, oil had been avoided.

A MEMBER said he had had considerable experience with Diesel engines. To avoid difficulties the cores had been made in halves, which made them very easy to make though more difficult to assemble.

MR. MARAIS asked why use an oil if it was not necessary, as it was an expensive item?

The PRESIDENT considered that this was a very debatable point. Incidentally, he found that a clay put into a core of that type made for difficulty in cleaning the core from the barrel. With a sea sand plus oil core all the sand ran out after being cast by merely tapping the casting.

MR. MARAIS said that for the casting he mentioned a clay had been chosen that would give a low dry strength, and very little cleaning was necessary.

Desilting Operations

MR. SNOW raised the question of desilting. He believed that all modern sand plants had a desilting system on the sand circuit. Was this really necessary, and where did the silt come from?

MR. MARAIS said he had read a great deal about desilting, and had been in contact with desilting at Iscor. Almost any modern sand condition plant had a desilter in the circuit. His own personal experience with two plants having no desilting facilities, and operating on synthetic sand for approximately six months, was that the permeability had increased instead of decreasing.

MR. TEUBES said that his company's desilting plant had been out of action for three weeks, during which period the permeability dropped by two points per day; so much so that they had to throw out some sand and bring in fresh. This might be due to the heavy castings produced. Silt was formed from the heat generated in the mould from molten iron. The grains split and unless the position was remedied by a desilter the split grains would accumulate. It might be that the foundries of which Mr. Marais was speaking were not casting a very heavy type of mould.

MR. MARAIS said that in one particular case the core sand was knocked out into the moulding sand and was slightly coarser, which might be the reason for the permeability increasing instead of being reduced. They had stopped knocking out the core sand, however, and the permeability still increased. The burnt sand was also scraped off all the castings and returned to the system again.

Answering Mr. Alexander, MR. MARAIS said that the green strength was kept constant by a small addition of clay, so small that it did not seem to affect the permeability at all. He agreed with Mr. Teubes that new sand had a tendency to crack up, but when it had been in use for a month no more grains would crack as the sand would be thermally stable.

MR. SNOW said that almost every desilting plant must of necessity abstract a certain amount of clay bond. Did this necessitate the addition of extra bond?

MR. TEUBES said that practically the same quantity of bonding material was used whether desilting or not. When new sand was introduced the bonding addition had also to be increased.

MR MACKAY considered that the importance of desilting was over-rated. In his opinion it was only necessary to desilt about once every four years. One important function of the suction plant was to cool the sand. If sand was circulating, say, once every two hours, it did get very hot. A synthetic sand presented far greater possibilities of milling at a high temperature than a natural sand. Bentonite in any form (of natural clay) did bond very readily in a mill, whereas a natural sand did not, when hot. Using synthetic sand, over a period of, say, four months, only about 400 lb. of silt was drawn off by the dust extractor and still the permeability increased.

The PRESIDENT said that Mr. Marais had mentioned three types of mills. Which type did he advise to obtain the most constant and efficient mixing?

MR. MARAIS said that in a highly mechanised foundry he would unhesitatingly advocate a continuous mill. For less highly mechanised establishments and facing sands, he considered that a batch mill would be more satisfactory.

MR. ALEXANDER asked whether synthetic sand was not easier to mill and so more amenable to treatment in a plate mill.

MR. MARAIS said that he had recently been at a foundry where synthetic sand was used for the first time and everybody remarked how clean the sand came from the mill. Synthetic sands were being used in many foundries with no mill at all, and the idea that a mill was necessary for synthetic sand was a fallacy.

MR. MARAIS said that he certainly would not advocate a highly mechanised foundry operating without a mill. Two of the castings on view had been made in synthetic sand that had not been milled, but the foundries in question were certainly using more clay than they should.

Research on Sands

A MEMBER asked whether any research was being undertaken in the Union to tabulate local sands and whether any pamphlets had been published, and also whether local clays were as good as imported clays.

MR. MARAIS said that Iscor was carrying out extensive research, while the East Rand Engineering Company, Limited, and several other firms had also been doing their share. The universities had also taken over this

work to a certain extent, but he considered that they lacked the necessary experience. As far as the clays were concerned, the local clays were certainly good.

MR. DRUMMOND said that, as members knew, some time ago the Institute decided to start negotiations with the Government Metallurgical Laboratory concerning the location of certain sands suitable for foundries. It was then reported that the South African Council for Scientific and Industrial Research was going to be formed. The Council had now been launched and had set up its physical laboratory. One of the first tasks to be undertaken would be foundry sands research. He thought that in the very near future the Council would be able to make a statement. A prominent member of the branch had recently been appointed by the Transvaal Foundry Association to the Standards Committee for refractories.

MR. LION-CACHET said that Dr. Schonland, during a recent tour of industries in Germiston, had said one of first problems to be tackled would be research on sands, and he had assured him that he could count upon the whole-hearted co-operation of the Institute.

A London Visitor's Views

Asked by the president to address the meeting, MR. PATERSON said that, while listening to the excellent Paper and discussion, he could imagine himself at a meeting of the London branch at home. He had seen many industries in South Africa, and the industrial progress which appeared to have been made had been a revelation. He had seen goods comparable with those of Birmingham being made by the most modern methods. Again, he had seen other methods which were not so modern. One thing which had struck him on his visits to foundries was the sight of the native, who seemed to be everywhere and served the moulder hand and foot, doing jobs which he would do himself at home. He wondered whether the costing department had found that this form of native labour was really so cheap. He was concerned with mechanisation, and the very large plants put down in Britain had reduced costs enormously. In Britain to-day one of the biggest difficulties was lack of labour. One day South Africa might experience the same trouble. Considerable attention was being made to making the foundry attractive to the young man. It had been found that moulders diverted to other industries were not returning to the foundries. Many foundries in Britain were trying to bring their premises up to date by laying down concrete floors, air conditioning, etc., and making their foundry like a factory. He was certainly of opinion that a much better article would be produced in a clean, comfortable foundry in which the men liked to work. That was the modern tendency. He considered that the future of South Africa was unpredictable, since the country seemed to have everything that was required. His visit had been a wonderful experience.

Lead Castings.—One of our readers asks us for a source of supply for lead castings weighing about 5 tons.

PUBLICATIONS RECEIVED

The Training of an Engineer. Published by W. C. Holmes & Company, Limited, of Turnbridge, Huddersfield.

This dignified brochure has been published with the object of interesting intending apprentices in the products and organisation of the firm. The firm was established in 1850, and since that time has taken a prominent part in the equipping of gas undertakings throughout the world. The first 20 pages tell of these developments, and this is followed by a detailed statement in simple language of what takes place in each department. Both sections are adequately illustrated. Finally, there is a lengthy section devoted to the apprenticeship training scheme. Herein, the reviewer thinks too much stress is laid on the money reward for craft proficiency and evening class examination passes. If such a policy appeals to hard-headed Yorkshire lads, then an extension of the 2d. per hour should be given to read, "about £20 a year." Emphasis is laid, and rightly so, on the facilities for promotion to executive positions. The system detailed does not—except for those who have shown aptitude at evening classes—provide for daytime instruction, as will be necessary under the new Education Act. Apart from these criticisms, the scheme disclosed is excellent. Especially does the reviewer like the idea of a series of lectures on the products of the company, associated with visits to customers' works.

Monthly Bulletin of Statistics (No. 7). July, 1946. Published by the Economic Intelligence Service of the League of Nations, and obtainable from Allen & Unwin, Limited, 40, Museum Street, London, W.C.1. Price 1s. 9d.

This issue contains new statistics relating to France, Italy, Greece, Hungary, Poland, Czechoslovakia, Union of South Africa, and Sweden. A most interesting feature is the disclosure that in 1945, 90 to 94 per cent. of the import-export trade of Poland was with Russia, whilst for the first quarter of this year it has been reduced to 80-81 per cent. Imports have consistently been less than exports, of which in 1945 coal was 89 per cent. The reviewer hopes that arrangements will be made for this section of the work of the League of Nations to be continued.

"Whiting Founder," the house organ of the Whiting Corporation, Harvey, Ill., U.S.A.

The Spring-Summer issue of the "Whiting Founder" contains a real "pep" leader, which suggests that a director looking for genius to run his foundry should, day after day, walk round the shops with his mind receptive to new ideas, and he will eventually discover himself as the genius. There is illustrated and described a neat turntable running on ball bearings for foundry trucks. Other articles describe a small mechanical cupola charger; a new line of ladles which align themselves with the best European practice, and a holding furnace for ensuring the uniformity of composition and temperature of cupola-melted irons.

WASTERS DUE TO ASSEMBLERS

By "CORONER"

Waster castings can sometimes be caused by a very simple thing, as for example, when making a runner basin, the use of a pattern to ensure a good firm basin is to be preferred to the moulder cutting the basin out of a box of sand, yet unless care is taken wasters may result. On one occasion the employment of such a pattern to avoid defects from sand inclusions in the mould, led to another defect which at first it was difficult to diagnose.

A particular wheel, with a light rim was being made in a high-duty iron, and a number would periodically be scrapped due to a lump of sand dropping from the top and causing a defective rim. It was at first thought that the moulds, which were of dry sand, and machine-moulded, were not being reinforced correctly and thus, on turning over for assembly, a piece dropped off. This, it was found, was not the case, as the mould could be turned over and assembled and again lifted any number of times without any sand dropping.

The actual cause of the trouble was spotted by the foreman when casually watching the assembler building up the runner basin. For this purpose he placed a runner stick in the downgate and shovelled a layer of sand within the box placed around it. Next he placed the aluminium pattern of the basin in position and proceeded to bed it down to ensure a firm bottom for the basin. In doing this, he occasionally—according to the position of the basin—struck a stay used to reinforce the top and thus knocked off a lump of sand, with the aforementioned result.

After this experience, all assemblers were instructed to exercise particular care in this operation, since which time no further defects have been recorded from this cause.

A.F.A. GRAY IRON GROUP

The appointment of an advisory group to the Gray Iron Division of the American Foundrymen's Association is announced by Mr. T. E. Eagan, chief metallurgist, Cooper-Bessemer Corporation, Grove City, Pa., chairman. The members of the new committee are: Mr. A. L. Boegehold, head of the metallurgical department, Research Laboratories Division, General Motors Corporation, Detroit; Mr. John Bolton, metallurgist, Lunkenheimer Company, Cincinnati; Mr. H. Bornstein, director, testing and research laboratories, Deere & Company, Moline, Ill.; Mr. V. A. Crosby, metallurgical engineer, Climax Molybdenum Company, Detroit; Mr. R. F. Harrington, assistant works manager, Hunt-Spiller Manufacturing Corporation, Boston; Mr. Max Kuniansky, vice-president and general manager, Lynchburg Foundry Company, Lynchburg, Va.; Dr. C. H. Lorig, metallurgist, Batelle Memorial Institute, Columbus; Dr. J. T. MacKenzie, metallurgist, American Cast Iron Pipe Company, Birmingham, Ala.; Mr. G. P. Phillips, chief metallurgist, automotive foundries, International Harvester Company, Chicago; Mr. F. G. Sefing, research metallurgist, International Nickel Company, Inc., New York City; and Mr. E. K. Smith, consulting metallurgist, Beverly Hills, Calif.

A NEW FEEDING TECHNIQUE FOR CASTINGS

Mr. T. E. Lloyd, the Pittsburg regional editor of the "Iron Age," has described the use of a new proprietary exothermic material known as Thermotomic as used in foundry practice. The following is an abstract of his report.

Reduced feeder head size, lower cleaning and finishing costs as well as sharply lessened scrap losses are said to result from the use of Thermotomic, a new exothermic material developed by Pittsburgh Metals Purifying Company. The material can be moulded into core rings for use as feeding rings, or can be mixed with facing material when such an application is desirable.

In practice, Thermotomic, which is available in powder form, in consistency much like sand, is formed into suitable core shapes. A concave area around the waist of the cake core carrying centrally the runner hole provides a means of locking the core in the gate or head. This particular core is moulded into the head basin. When the hot metal passes through it, the reaction is started and the compound in the core glows at a temperature high enough to contribute materially to the heat in the metal in the head, thus delaying solidification of the head and permitting it to feed molten metal to the casting over a longer period of time. This action has materially reduced shrink losses and porosity in such castings as bearings and rolls.

When the burning action is completed and this action can be controlled to range from several minutes up to 60 hrs., the core proper remaining shows a hard, refractory structure, retaining its original size and shape. The erosion of the core is negligible. The softening point of the burned-out Thermotomic core is believed to be in the neighbourhood of 1,760 deg. C. As a heat source, an independent testing laboratory has reported it capable of generating 3,475 B.Th.U.'s per lb. of compound.

Thermotomic is said to impart no impurities to the metal, and, containing no carbon, sulphur, or phosphorus, does not increase the quantities of these elements in the metal. It has found use in both ferrous and non-ferrous work. In forming into shapes, such as cores, Thermotomic is mixed only with water. It is tempered to a consistency of a dry core sand, or to a moisture content of 4 to 6 per cent. After forming, the core or part is dried in an oven at a temperature of from 176 to 204 deg. C. until thoroughly dry. The baking temperature is sufficient to dry out the core completely, but it is not great enough to set off the reaction. In a confined area, such as in a feeder head, temperatures in the range of 426 deg. C. will initiate the reaction. It has been found that generally no further feeding of the head is necessary after the initial pouring.

AN "ON SITE" SALE of 400 machine tools is to be opened by the Ministry of Supply at Desford Airfield, near Leicester, on August 28.

HOT-BLAST CUPOLA DESIGN

By E. LONGDEN, M.I.Mech.E.

(*Continued from page 395.*)

Griffin Hot-blast Cupola

The best-known hot-blast cupola is illustrated in Figs. 9 and 10. The hot-blast system has been most carefully and scientifically worked out by Mr. F. K. Vial. It will be noted from Fig. 9 that a hot gas duct is located at a point above the preheating zone through which between 40 to 50 per cent. of the ascending gases are conducted aided by an exhauster fan at the final stage of the system. The gases, which contain a percentage of incompletely burnt carbon monoxide, pass down a vertical lead-duct to a combustion chamber where most of the carbon monoxide is burned to carbon dioxide. The revived gases with the increased B.Th.U.'s then pass through a large number of vertical iron tubes located in a chamber above the combustion box. A large amount of heat is absorbed by the tubes before the gases flow to the exhauster. Air is passed into the heated tube chamber and then through the warm-blast pipe to the air belt and tuyeres into the combustion zone of the cupola. The temperatures recorded at various points of the system are indicated in the sketch, Fig. 10.

The work of Vial reveals the additional studies from which certain principles have been well established in respect to the theory of heat transfer for preheating air as follows:—(1) The laws regarding the transfer of heat through the walls of metal tubes; and (2) the amount of air to be heated, and the amount of gases available for furnishing the heat, are variables through a wide range.

The amount of coke per ton of iron melted may vary from 130 to 200 lb., and the amount of air required for the combustion of 1 lb. of coke varies from 7.5 to 8.5 lb., depending upon the efficiency of combustion. A complete analysis involves the study of combustion in relation to coke analysis and excess or insufficient supply of air; the efficiency of the absorption of the heat developed by the iron melted and the temperature to which it is desired to melt the iron.

The amount of coke required to melt a ton of iron is indicated in a monthly statement of all Griffin cupolas which show an average consumption of 150 lb. exclusive of bed coke. The Association of Manufacturers of Chilled Car Wheels recently issued a statement showing the performance of 18 cold-blast cupolas in which the average amount of coke required for melting a ton of iron was 216 lb., the range being from 200 to 248 lb. the average difference between the two processes—hot or cold—is 66 lb. per ton of iron melted. The annual output exceeds 1,000,000 tons of iron melted. The cold blast therefore uses 44 per cent. more coke than the hot blast. This is not a theory, but the result of large-scale production. It is also reported that there is an increase of 20 per cent. in the melting rate where hot blast is used.

Longden Hot-blast Cupola

Generally, the publicised hot-blast cupola systems are based on the use of heated air through the agency of the normally high temperature and incompletely burned

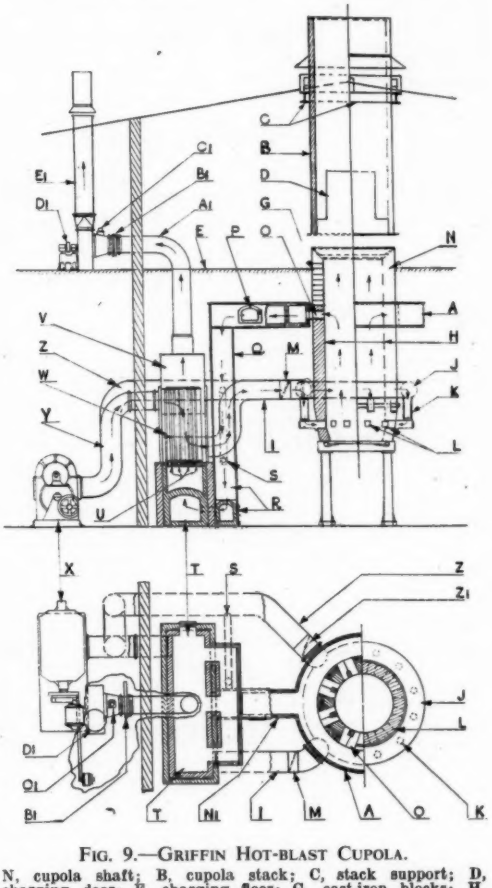

FIG. 9.—GRIFFIN HOT-BLAST CUPOLA.

N, cupola shaft; B, cupola stack; C, stack support; D, charging door; E, charging floor; G, cast-iron blocks; H, cupola lining; I, heated air pipe; J, air belt; K, tuyere leads; L, tuyeres; M, blast gate valve; A, annular outlet gas duct; O, gas outlets; P, cleaning door; Q, vertical gas duct; R, unburned gases; S, by-passed air to complete burning; T, combustion chamber; U, distribution zone; V, hot-blast heater with 256 tubes; W, baffles; X, blower; Y, cold blast; Z, emergency cold-blast main; Z1, emergency cold-blast gate-valve; A1, burned and exhausted gas; B1, slide-gate; C1, by-pass gate; D1, exhauster; E1, exhaust chimney; N1, horizontal gas duct.

Hot-blast Cupola Design

gases escaping to the stack and slag hole, or by utilising the heat units absorbed by the lining of the cupola.

Basis of New Hot-blast System.—The new system to be outlined is based on supplying the combustion zone of the cupola separately with incompletely burned gases, consisting mainly of carbon monoxide, and with preheated air, the hot gases being produced in an independent generator outside the cupola, and the air being preheated by the hot gases from the generator without being mixed or brought into actual contact with gases until the combustion zone of the cupola is reached. Figs. 11 to 13 illustrate the hot-blast system. The tests were made on a cupola of 40-in tuyere zone lining dia., and a 44-in. melting zone dia

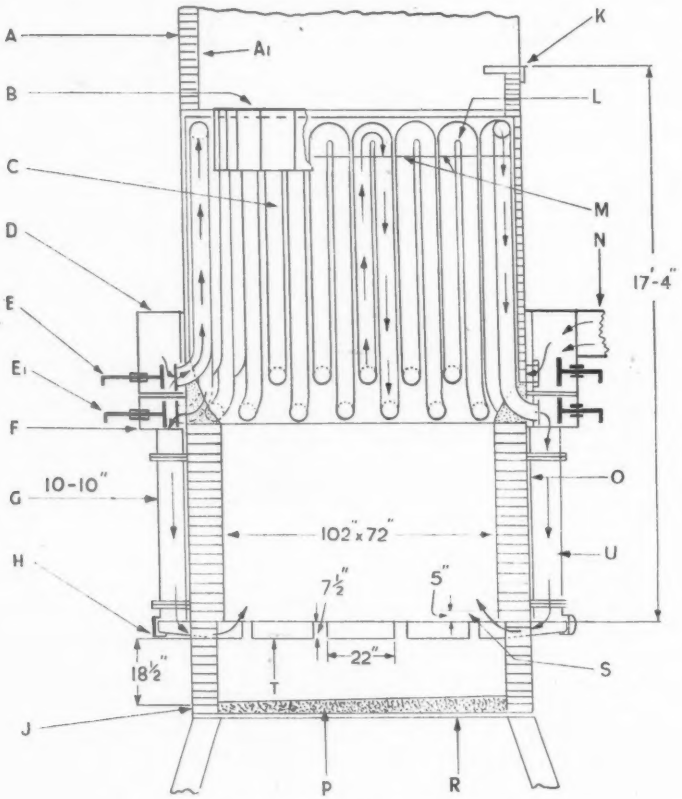

FIG. 8B.—GENERAL ARRANGEMENT OF AIR HEATER PIPES

A, cupola shell, A1, cast-iron bricks; B, cast-iron protection plates; C, special cast-iron superheater tubes; D, cold air bustle pipe; E, cold air cut-off valve; E1, hot air cut-off valve; F, hot air bustle pipe; G, 10—10 in. down-lead pipes; H, one row of 10 tuyeres; J, tap hole; K, charging door sill; L, return bend; M, slip joints N, blast-inlet pipe; O, high grade fire bricks; P, bed sand; R, bottom door; S, melting starts 5 in. above tuyeres; T, total area of tuyeres at entrance = 1,650 sq. in.; U, total area of down-lead pipes = 785 sq. in.

The general arrangement of the cupola is shown in Fig. 11 with a sectioned view of the independent generator at C.C. Cold air is delivered from a blower to the blast pipe, K. The air is apportioned in the header box, G, to provide air for the generator, D, and air for the cupola, P. The amount of air to the generator and cupola is precisely controlled and balanced by a single manipulation of the air-apportioning valve, H. Approximately 30 per cent. of the air is allowed to pass through the deep bed of fuel in the generator. The products of combustion then pass along the internal gas main, L, into the internal gas belt, S, and into the combustion zone of the cupola through the section, U, of the double tuyeres, T. The remainder of the air required for combustion in the cupola passes across the generator header, G, to the external air-blast delivery jacket pipe, M, into the external air belt, R, and thence through the air section, V, of the double tuyeres, T, and the single tuyeres, W, into the combustion zone of the cupola.

The other main features of the system will be noted in the descriptive matter at the base of the illustrations. Fig. 12 shows the general design and setting of the main dual air and gas tuyeres, T, and the air tuyeres, W. Fig. 13 illustrates an alternative type of twin generator. The two fire boxes are fired independently, and so controlled to pass a continuous supply of heated gas to the cupola.

When working, air flows through the blast main, G, from the blower into the header box, B. The requisite amount of air to the twin fire boxes is supplied and controlled by the slide valves, H. The remainder of

the air required for completing combustion in the cupola passes across the header box, B, to the external blast main, T, and thence to the cupola, as previously described. The products of combustion, generated in the twin fire boxes, pass into the distribution pipe, R, into the internal gas main, S, and on to the cupola in the manner described in the general description of Fig. 11.

The fire boxes are replenished with fuel alternately. A manipulation of the slide valves, H, which, when actuated, simultaneously closes the gas exit into the distribution pipe, R, and the air input of the fire boxes

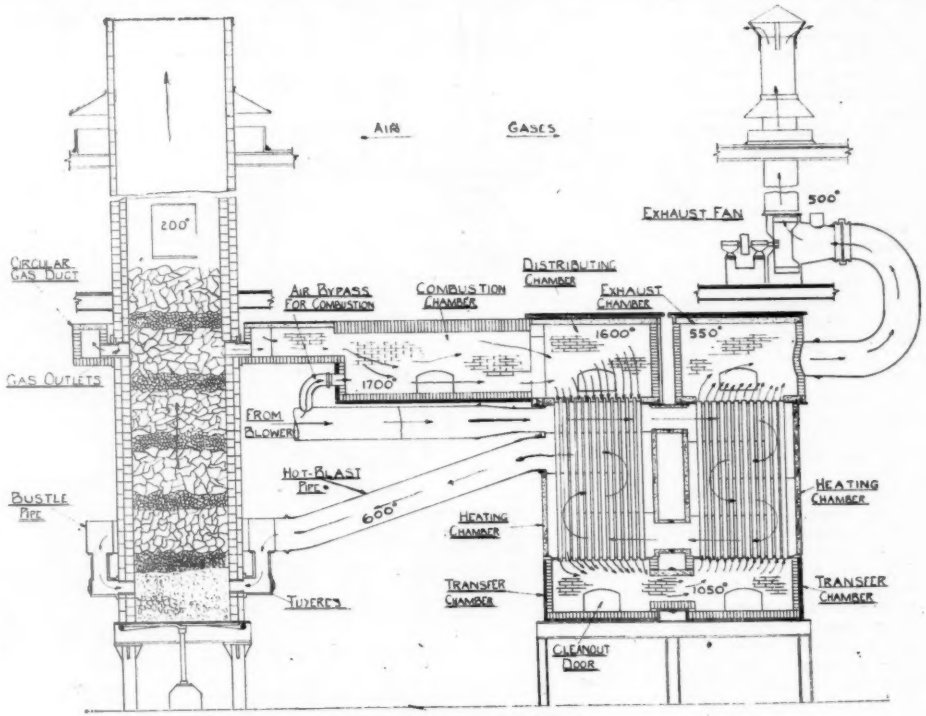

FIG. 10.—GRIFFIN CUPOLA.

to be refuelled. During the fueling period the gases of slow combustion find relief through the chimney, D.

Advantages of the New Hot-Blast System.—A number of tests were conducted to ascertain the value of the new hot-blast system. Because of war conditions, however, the tests were incomplete since they did not, for instance, include either gas or slag analysis. They were, however, of a very encouraging character. One of two 6- to 7-ton cupolas of identical construction and air input capacity was altered to accommodate the additional attachments of the new system. Thus the performance of the two cupolas, one operating with cold blast and the other with hot blast, could be readily compared. The results of the most reliable test taken, with all materials charged into and consumed by the cupola, as carefully weighed and checked as possible, is summarised in Table III.

The coke to metal ratios cannot be said to be any improvement on normal practice; they are, however, comparative. During the periods of tests the fuel supplies were inferior, and the first consideration was to melt metal at the best temperature to produce a suitably sound casting. The general advantages of the hot-blast system may be stated as follows:—

(1) Hot air is obtained immediately the cupola is put under blast.
(2) Improved control over the properties of the metal.
(3) Economy in fuel consumption.
(4) Brighter tuyere combustion zone.
(5) Reduced consumption of limestone.
(6) Lowered consumption of lining refractories.
(7) Increased rate of melting.
(8) Extended melting period.

E

Hot-blast Cupola Design

(9) Reduced loss of iron.

(10) Improvement in tapping temperatures.

Improved control of the metal can be expected since there is less fuel burned in direct contact with the metal. This will allow of a lower carbon pick-up when melting steel-mix metals of the high-duty quality and, also, there is a lower sulphur absorption. There is distinct evidence of a reduced iron, silicon and manganese loss.

Fuel economy results from the burning of cheap low-grade fuel in the generator fire box, and the increased temperature, brilliance, and consequently quickened chemical activity, in the combustion zone of the cupola due to the introduction of heated combustion air, and high-temperature gases from the generator. The increased turbulence, and from it the more perfect mixing of the gases at an early stage, will increase the efficiency of combustion. There is also a reduction in the flux used for which less fuel will be needed to fuse it.

The tuyeres remain bright and clean over longer periods, when compared with the cold-blast systems, because the chilling influence of the hot air on the formation of the slag bridge above the tuyeres is very considerably reduced. This improvement also extends the possible length of time the cupola can be used during any single heat. The pressure of the blast allows slag to be retained on the slag bridge, thus a more prolonged and more concentrated chemical attack on the lining. Any retardation and reduction of the slag bridge formation will, therefore, reduce lining wear.

The temperature of the gases and air throughout the system, before entering the combustion zone of the cupola, is indicated in Fig. 11. It will be noted that the temperature of the air increases fairly rapidly in direct ratio to the length of the path it travels, and the gases of combustion fall in temperature in direct ratio to the length of the path traversed. From these observations it is possible to calculate the length of air blast and gas main needed to establish approaching equal temperatures between the heated air and cooled gases of combustion before entering the cupola.

Such a design as the one outlined can be justified

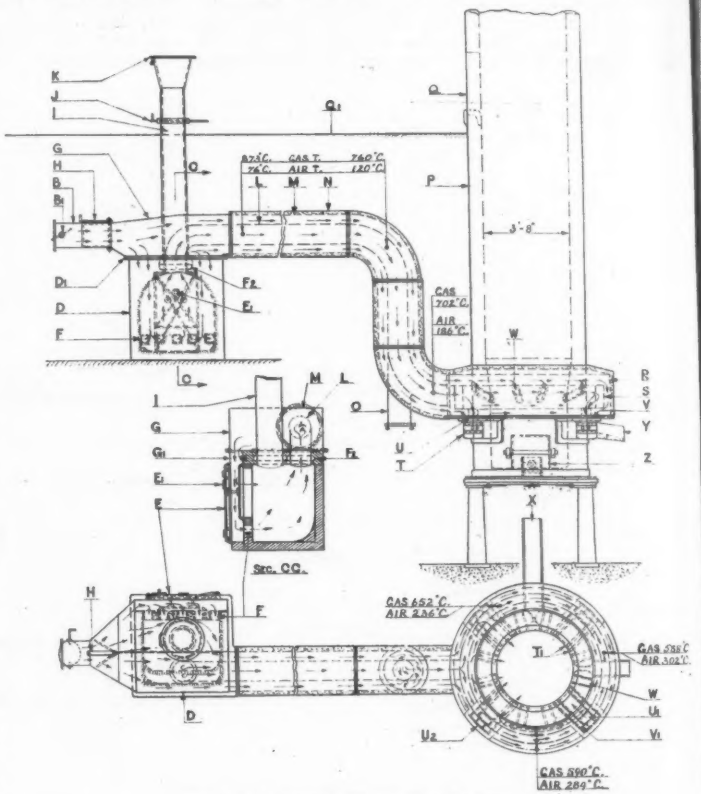

FIG. 11.—LONGDEN HOT-BLAST CUPOLA.

B, fan blast pipe connection; B1, fan outlet main valve; D, primary combustion fire box; D1, bolted joint; E, fire box double door; E1, sight and trimming hole; F, fire box air tuyeres; F2, air cooling passage; G, fire box air distribution head; G1, air passage between doors; H, air apportioning valve; I, fuel feeder; J, fuel feeder valve; K, fuel feeder lid; L, combustion gas main supply pipe; M, heated air main supply pipe; N, insulation material; O, dust trap; P, cupola; Q, charging door; Q1, charging platform; R, distribution belt for heated air; S, internal distribution belt for combustion gas; T, double tuyeres for heated air and combustion gas; T1, inner replacable double tuyere; U, connection to outer tuyere for combustion gas; U1, combustion gas tuyere; U2, cupola combustion zone sight hole through U1; V, entrance for heated air to tuyere section, V1; V1, heated air tuyere section of double tuyere, T; W, upper tuyeres for heated air; X, liquid metal outlet spout; Y, slag spout; Z, fettling door

TABLE III.—*Summary of a Test on Cupolas.*

	Cold Blast.	Hot Blast.
Internal lining dia.—tuyere zone ..	40 in.	40 in.
,, ,, ,, melting zone ..	44 ,,	44 ,,
Cold air pressure	17 in. W.G.	
Hot air ,, ...		16.6 in. W.G.
Hot gas ,, ...		17.2 ,,
Bed coke	17 cwts.	15¾ cwts.
Metal charge	17 ,,	17 ,,
Coke charge	200 lbs.	110 lbs.
Generator fuel (gas coke), per charge of metal		90 ,,
Limestone per charge	56 ,,	40 ,,
Total metal melted	28 tons	28 tons
Fuel to metal ratio excluding bed ..	1 to 9.8	1 to 9.8
,, ,, including bed ..	1 to 7.5	1 to 7.68
Hourly melting rate	6.4 tons	7.5 tons
Metal loss	5.2 per cent.	3.92 per cent.

TABLE IV.—*Comparative Tests.*

General Iron.

Cold Blast, Average of 6 Tests

	T.C.	Si.	Phos.	Mn.	Su.
Maximum	3.32	1.73	0.80	0.65	0.116
Minimum	3.25	1.62	0.76	0.59	0.102
Average	3.28	1.69	0.78	0.62	0.112
Hot Blast, Average of 7 Tests.					
Maximum	3.19	1.78	0.81	0.73	0.104
Minimum	3.14	1.70	0.74	0.66	0.098
Average	3.16	1.74	0.77	0.70	0.102

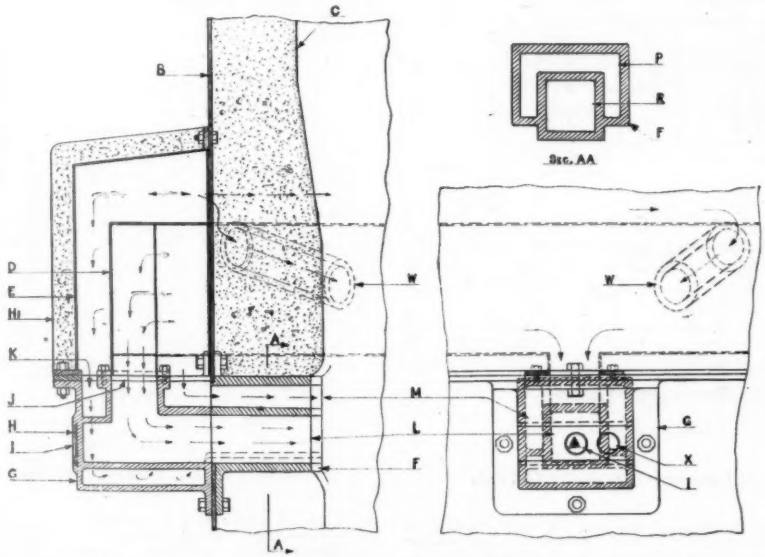

FIG. 12.—LONGDEN HOT-BLAST CUPOLA—GENERAL TUYERE ARRANGEMENTS.

B, outer shell of cupola; C, inner face of brick lining; D, inner belt for distribution of combustion gas; E, heated air belt; F, inner double tuyere; G, double tuyere control box; H, tuyere box slide door; I, observation window; J, inlet for combustion gas; K, inlet for heated air; L, cupola inlet for combustion gas; M, cupola inlet for heated air; W, upper tuyeres for heated air; X, trimming hole; H1, insulation material.

SECTION AA.

F, inner double tuyere; P, heated air section of inner double tuyere; R, combustion gas section of inner double tuyere.

for the great majority of medium and small cupolas melting comparatively small quantities of metal over blowing periods of up to 4 hrs., because the benefits of heated air are obtained immediately the cupola is put under the blast. To apply the system to larger cupolas is a still more economical proposition.

The new system should have a special application to the production of cupola-melted metal to the necessarily close limits required for both whiteheart and blackheart malleable iron, high-silicon acid-resisting iron, high-duty irons, and even certain classes of non-ferrous metals.

Hot-blast Cupola Design

Dyer Hot-blast Cupola

It was not until the usual search was made by the Patent Office, after the filing of the application of the new hot-blast system, that the Author became aware of a previously registered hot-blast cupola, designed to improve the control over the properties of cupola-melted metal by burning a proportion of the fuel in a generator outside the main cupola shaft. Fig. 14 shows an outline of this cupola designed by Dyer, U.S.A. No data are available as to the success achieved by this design. The conception would appear to be rather vague.

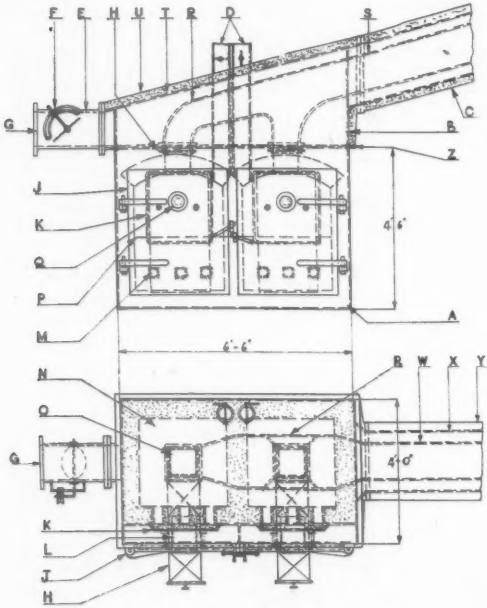

FIG. 13.—LONGDEN HOT-BLAST CUPOLA.

A, twin primary combustion fire box; B, air distribution header box; C, heated air and hot combustion gas mains; D, temporary gas escape chimneys; E, fan blast pipe connection; F, fan blast pipe valve; G, air entrance from fan; H, air apportioning valve; J, fire box outer main door; K, inner fire box door; L, primary combustion air inlet; M, air inlet tuyeres; N, combustion chamber; O, outlet for products of combustion; P, top of front fire-brick fender; Q, sight and trimming hole; R, inner hot combustion gas header; S, inner hot combustion gas header joint; T, heated air chamber; U, insulation material; W, inner main pipe for hot combustion gas; X, outer main pipe for heated air; Y, insulation material; Z, air distribution header box joint.

Whiting Hot-blast Cupola

The Whiting Corporation, U.S.A., has recently supplied some particulars of a hot-blast cupola. The air for combustion is preheated through the agency of heat obtained from burning fuel in an external firebox. This cupola is illustrated in Fig. 15. It will be noted by reference to Fig. 15 that cold air passes from a blower, A, into the blast main, B, it then enters a series of tubes, C, arranged in a heating chamber, D, from which the air enters the warm-blast main, E, and on to the combustion zone of the cupola, F. The automatic stoker, G, feeds fuel to the external firebox, H, from which the products of combustion pass to the air preheating chamber, D. After giving up heat to the tubes, C, the gases are exhausted through the chimney, J, to the outside atmosphere.

The designers point out the benefits of preheated air in controlling consistency, and the quality of the metal in this warm-air cupola. No performance data are available.

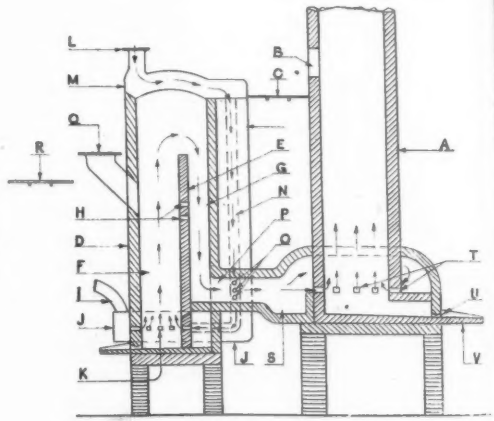

FIG. 14.—DYER HOT-BLAST CUPOLA.

A, cupola melting shaft; B, charging door; C, charging floor; D, detached generating chamber; E, vertical baffle wall; F, Chamber for burning fuel; G, passage for gases forced by mechanical pressure; H, openings for gases to passage, G; I, air from positive blower; J, wind box partially encircling chamber, F; K, tuyeres; L, second delivery of air; M, series of pipes which form the dome of chamber, F; N, conduits through which to wind box J, air is heated to 315 deg. C. before passing through tuyeres, K, and as they pass to gas main recuperative system, P; O, air jets for free air from conduits, N, to create the maximum of carbon dioxide; P, gas main; Q, fuel charger; R, charging floor; S, gas belt surrounding cupola; T, plurally gas ports; U, tap hole; V, tapping trough.

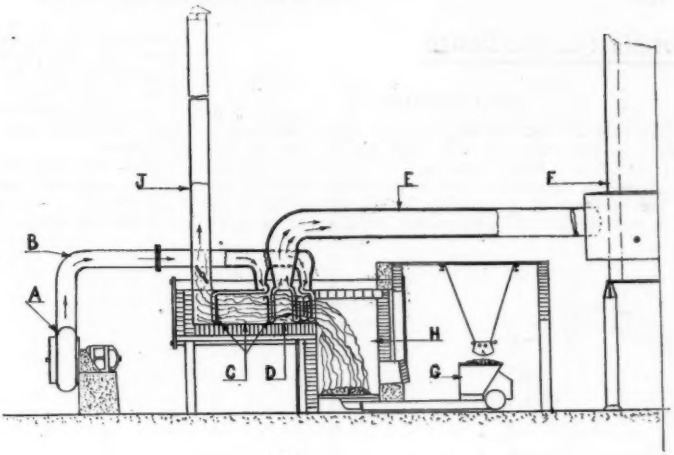

FIG. 15.—WHITING HOT-BLAST CUPOLA.

A, the blower; B, the air blast main; C, the heater tubes; D, the heating chamber; E, the warm blast main; F, the cupola; G, the automatic stoker; H, the external fire box; J, the gas exhauster chimney.

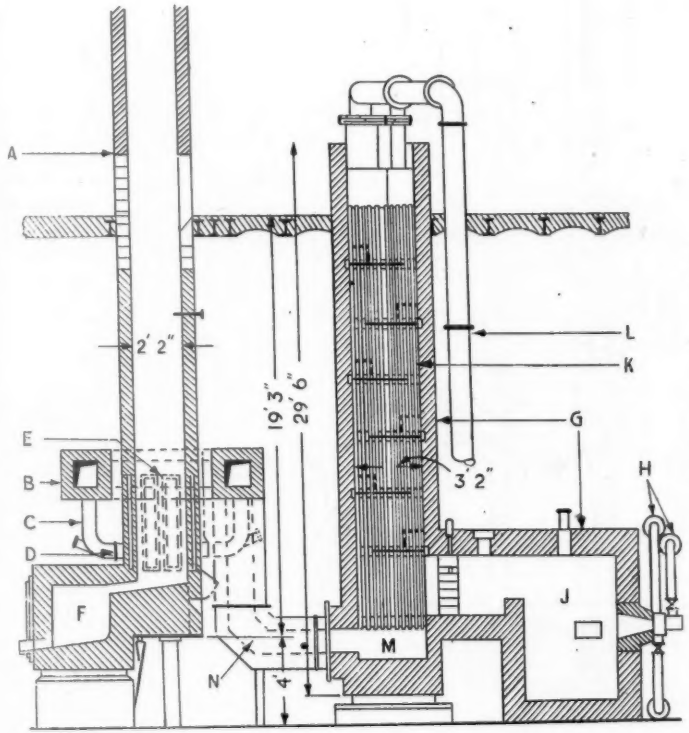

FIG. 17. — PIWOWARSKY HOT-BLAST CUPOLA. IRON AND STEEL WORKS, SCHAFFHAUSEN, SWITZERLAND.

A, cupola shaft; B, preheated air belt; C, air leads to tuyeres; D, water-cooled tuyeres; E, water-cooled lining; F, receiver; G, air preheating plant; H, air and producer gas; J, combustion chamber; K, heat exchanger tubes; L, cold air supply; M, preheated air chamber; N, preheated air ducts to belt, B.

Hot-blast Cupola Design

CONCLUSIONS

The case for the hot-blast cupola seems well established, in particular by Vial with his Griffin cupola, and McKenzie's Moore cupola. The hot-blast cupolas developed in Germany show a persistent examination of the problem of preheating the air for combustion. A certain measure of preliminary success can be acknowledged in the system of preheating air for cupolas based on the burning of a proportion of the fuel required to melt the metal in a generator outside the main cupola stack.

A comparatively wide range of hot-blast cupolas has been outlined with little contribution from British designers.

With the fuel situation in a dangerously acute condition, and until atomic energy can be harnessed to fuse metals, it will be necessary to practise the conservation of fuel.

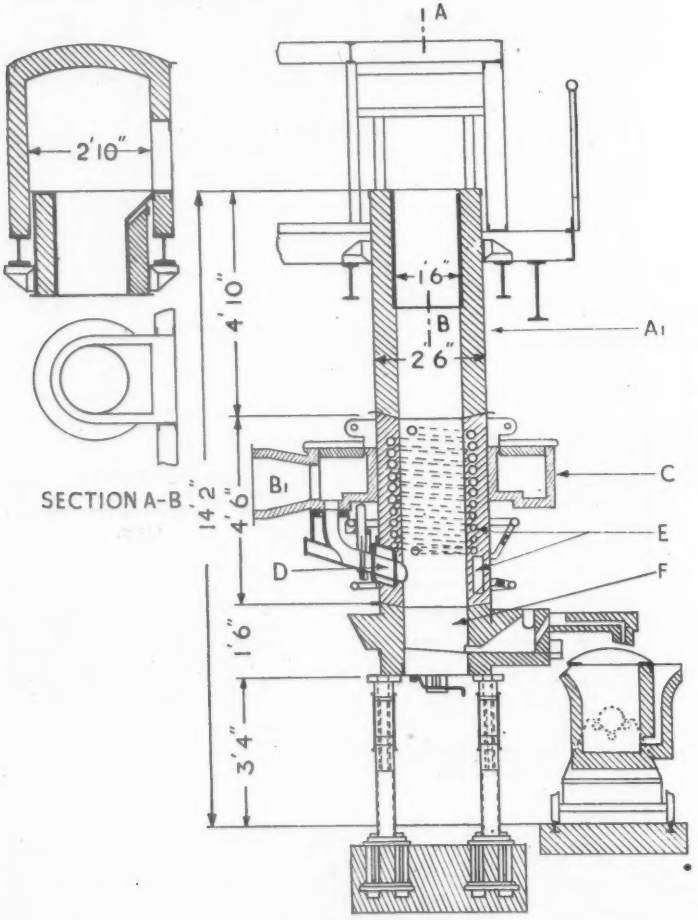

FIG. 16—PIWOWARSKY EXPERIMENTAL HOT-BLAST CUPOLA.

Sectional Elevation of Aachen Hot-blast Cupola.

A_1, cupola shaft; B_1, preheated air blast main; C, preheated air belt; D, water-cooled tuyeres; E, water-cooled lining; F, receiver.

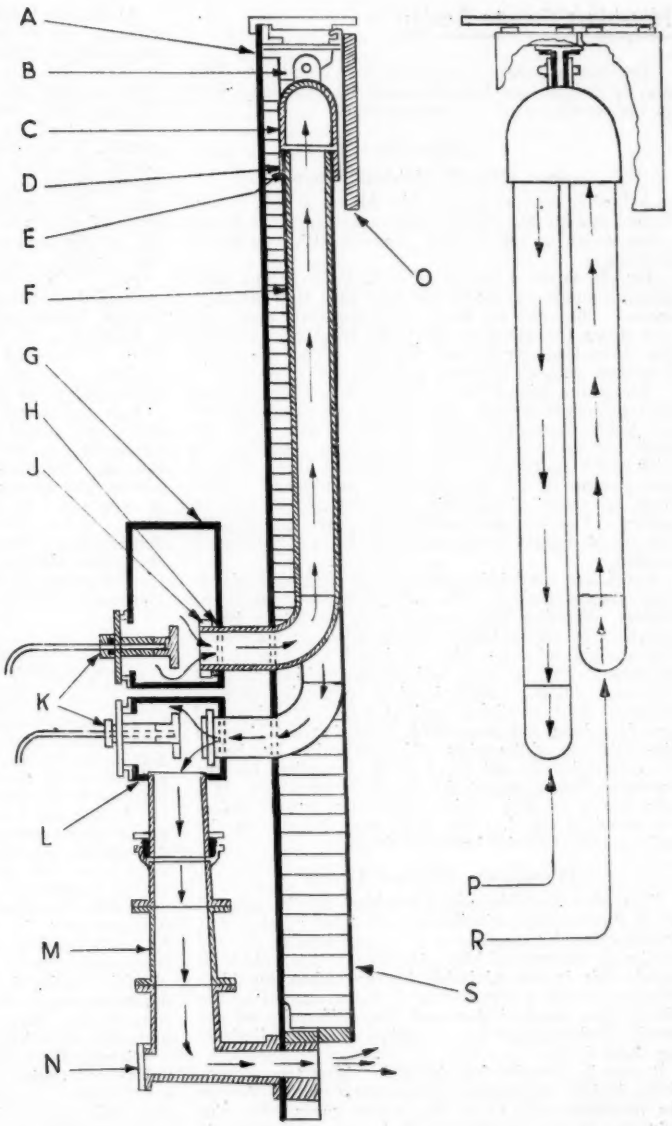

FIG. 8A.—MOORE-ACIPCO HOT-BLAST CUPOLA.

Part Cross-section of Cupola.

A, cupola shell; B, bracket; C, return bend; D, expansion joint; E, sealings; F, cast iron air heater tube; G, cold air bustle pipe; H, asbestos gasket; J, gland; K, cut-off valves; L, hot air bustle pipe; M, cast iron down-lead pipe; N, tuyeres; O, cast iron protection plates; P, hot air pipe to down-lead pipe M; R, air inlet pipes; S, cupola internal lining face.

Hot-blast Cupola Design

The Author's thanks are due to Mr. Wood, President. and the British Cast Iron Research Association for help in the search for certain information.

APPENDIX

Acipco (Moore) Hot-blast Cupola

A further improvement to the Moore cupola is illustrated in Figs. 8a and 8b. The heavy cast-iron heater tubes shown in Fig. 8 were replaced with a series of U-tubes.

Fig. 8a shows a section of a 72 in. x 102 in. link-shaped cupola equipped with the new tube arrangements. The cold air from the upper belt passes up and down the tubes to the lower wind belt, through the down-lead pipes and tuyeres. The cupola is furnished with 19 U-tubes and one row of tuyeres.

Below the heater tubes, the melting zone is lined with refractory bricks. Iron bricks are employed for the lining above the heater tubes because it is not subjected to such extreme temperature conditions as with cold-blast cupolas. Fig 8b shows a more detailed construction of the air preheating equipment. The tubes are made of cast iron, 5 in. internal dia., 13/16 section. The straight sections are cast centrifugally and the 90 degrees bends welded on by cast iron fusion welding.

Tubes and wind belts are made air tight with glands and asbestos gaskets. The tubes are anchored at the bottom, directing the expansion to the return bends above. The return bends are machined on the inside. The straight tubes are also machined at the ends and provided with cast-iron seal rings, making air-tight expansion joints. Each bend is suspended from a bracket. Flat cast-iron sections one foot wide and two feet long are suspended from brackets located above the top of the tubes. They extend to just below the return bends and serve as a protection for the expansion joints against the charging operations. If a tube begins to leak during operations, cut-off valves are provided so that the blast may be cut off the leaking tube and the heat completed.

Piwowarsky Hot-blast Cupola

Figs. 16 and 17 illustrate a hot-blast cupola designed by E. Piwowarsky. Piwowarsky is of the opinion that for high metal temperatures it is necessary to use the maximum amount of blast, but that in the cold-blast cupola this is not advisable because when the blast velocity exceeds a certain rate it is detrimental to the life of the cupola lining and the uniformity of the metal. Preheated air has a marked effect in eliminating these faults.

It may be thought that the higher blast temperature giving higher combustion temperatures would favour the formation of CO at the tuyere zones. But the reduction in the amount of fuel necessary makes it possible to exploit the advantages of the hot-blast cupola.

At the Aix la Chapelle Technical Institute, a thermal efficiency of 55 to 65 per cent. was claimed on the experimental cupola. Up to 18 per cent. CO_2 and 5 per cent. CO ratios were achieved with lower sulphur-content metal and increased metal output of up to 100 per cent. Metallic losses were slightly increased.

In view of the high temperatures obtained in the cupola, it was considered advisable to employ water cooled tuyeres (3) and water-cooling coils embedded in the lining wall about the combustion and melting zones. The cooling coils were covered with a 2-in. layer of plastic refractory cement. The internal lining dia. of the cupola was 18 in. This experimental hot-blast cupola is shown in Fig. 16.

Fig. 17 illustrates the Piwowarsky hot-blast design embodied in a cupola installed in the Iron & Steel Works, Schaffhausen, Switzerland. This cupola, with a lining dia. of 26 in. was first operated in February, 1941. It is used to melt metal for malleable iron castings. The air is preheated by a "Sicromal" heat exchanger plant which is fired by producer gas.

It is claimed that blast temperatures of 450 to 600 deg. C. are obtained with coke economies ranging from 18 to 38 per cent. along with improved tapping and pouring temperatures of the order of 30 to 50 deg. higher than in cold blast cupolas. Sulphur absorption is reduced. In the meantime, four additional hot-blast cupolas have been put into operation at the Schaffhausen Works. These cupolas have melted thousands of tons of metal for malleable iron castings Similar plants have been constructed in several large German foundries.

DUCTILITY AND ELASTICITY OF WHITE AND GREY IRONS

Although popularly considered brittle materials, white, mottled and grey irons may be manufactured with definite elasticity and ductility as well as reproducible tensile strength and other properties, it was pointed out in the Paper entitled "Ductility and Elasticity of White and Grey Irons," by R. A. Flinn and H. J. Chapin, metallurgical department, American Brake Shoe Company, Mahwah, N.J., and presented at the annual meeting of the American Foundrymen's Association, Cleveland, 1946. The Authors stated that as the matrix structure is changed from pearlitic to austenitic, the plastic elongation changes from 0.00 to 0.05 per cent. in white and mottled irons and from 0.05 to 3 per cent. in grey iron. Ferritic-pearlitic grey irons exhibit up to 1 per cent. elongation. Modulus of elasticity varies from 26.0 to 10.4 $\times$ 10^6 per sq. in., depending upon the structure. Hot tensile tests and concentrated load compression tests also indicate important ductility in certain of the above irons.

Microhardness data were given to provide the individual penetration hardness of the various structural constituents. A survey of established service applications was said to indicate that the elastic and plastic constants cited above may be equally as significant as tensile strength and hardness in determining casting performance.

ETHYL SILICATE

An interesting example of the way a relatively unknown chemical may suddenly assume industrial importance is provided by ethyl silicate. For a number of years a mixture of condensed ethyl silicates, sometimes known as silicon ester, has been available and used on a small scale as a binding medium. One of the earliest uses was in the preservation of stone, and many well known buildings such as Canterbury Cathedral, Warwick Castle and Bristol University have been treated with this material. Much of the pioneer work on silicon ester was carried out in the research laboratories of Albright & Wilson, Limited, at Oldbury, where ethyl silicate has been produced on a commercial scale for a number of years.

It has always been appreciated that ethyl silicate was capable of acting as a high-temperature cementing agent, but it was the modern jet engine that brought this property into prominence.

Ethyl silicate is now used in the manufacture of jet engine and gas-turbine blades. The investment moulding process of casting these blades from high melting-point alloys which are not easily machined, with a high degree of precision, calls for the use of a ceramic mould capable of withstanding high temperatures without distortion or cracking. Ethyl silicate has proved to be an extremely effective binding medium for the mixture of ceramics employed.

It is probable that there may be an extension of the gas turbine into other fields, for example, marine propulsion, so that considerable development may be expected in precision casting processes.

EXTRA SOAP FOR IRONFOUNDRY EMPLOYEES

Mr. Arthur Woodburn, M.P. for Clackmannan, has been kind enough to take up with the Ministry of Food the question of the provision of additional soap for ironfoundry employees. Dr. Edith Summerskill, the Parliamentary Secretary to this ministry, has sent a letter to Mr. Woodburn in which is listed a number of occupations where extra soap is given. Amongst these are coal miners and others handling coal. The following is a quotation from the letter:

All the people in industry who are now asking us for extra soap are being advised to approach their unions to make formal application to the T.U.C. Advisory Committee, and I suggest that you ask your people to take this course. I may say, however, that the T.U.C. do realise how difficult it is for any more concessions to be made so I do not wish to hold out too much hope to your constituents.

Thus, so far, there is no realisation at high levels that coal dust in foundry sand mixtures has the same soiling properties as coal dust arising from its winning and handling.

THE PRICE OF refined platinum has been advanced to £20 15s. per troy ounce following the recent increase in the London quotation from £17 to £20.

INSTITUTE OF METALS

The autumn meeting of the Institute of Metals is to be held in London on September 10 and 11. Technical discussions will take place at the Institution of Civil Engineers, Great George Street, S.W.1. The meeting will conclude with a luncheon at the Connaught Rooms, Great Queen Street, W.C.2, when ladies are cordially invited.

The programme is as follows:—

On September 10 (2.30 to 5.0 p.m.), "Antimonial 70 : 30 Brass," by D. McLean and L. Northcott; "The Hot-tearing Tendencies of Aluminium Casting Alloys," by D. C. G. Lees; and "The Application of Some Thermodynamical Principles to the Liquidus Surface of Alloys of Aluminium with Magnesium, Silicon and Iron," by H. W. L. Phillips, will be presented and discussed.

Two technical discussions will take place simultaneously on September 11 (10.0 a.m. to 12.30 p.m.). The Papers to be read and discussed in the lecture theatre are, "The Ageing of a High-purity Aluminium Alloy Containing 4 per cent. of Copper," and "The Cold-working of a High-purity Aluminium Alloy Containing 4 per cent. of Copper, and its Relation to Age-hardening," both by Marie L. V. Gayler; "Control of Internal Stresses in Heat-treated Aluminium Alloy Parts," by L. E. Benson; "Inverse Segregation in Cast Magnesium Alloys," by R. J. M. Payne; and "Intercrystalline Corrosion of Aluminium-Magnesium Alloy Rivets," by G. J. Metcalfe.

In the south reading room will be discussed "The Resistance to Corrosion by Sea-water of Some Alpha-Tin and Alpha-Tin-Aluminium Bronzes," by J. W. Cuthbertson; "Capillary Flow in the Soldering Process and Some Measurements of the Penetration Coefficients of Soft Solders," by A. Latin; "The Physical Properties and Temper-hardening Characteristics of Copper-Nickel-Manganese Alloys," by M. Cook and W. O. Alexander; and "Inert Atmospheres as Fatigue Environments," by H. J. Gough and D. G. Sopwith.

The luncheon takes place at 1.15 p.m., and members may ask as many guests as they wish.

TRADE UNION NEWS

The Journal and Report of the National Union of Foundry Workers, in its July issue, announces that in view of the recent amalgamation, the name of the enlarged body is to be the Amalgamated Union of Foundry Workers. It is stated that the membership of the new union will not be fewer than 60,000. Throughout this quarterly, there are well-reasoned arguments postulated for increased production. Thus up-grading has been supported, but the importation of Italian skilled labour has, it is gathered, not been favourably received.

BROOM & WADE, LIMITED, manufacturers of air compressors, pneumatic tools, etc., of High Wycombe, propose to convert their issued share capital into stock. On conversion the preference stock will be transferable in £1 units and the ordinary stock in 5s. units.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN

The following particulars relating to pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for July, 1946, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in June, with the number of furnaces in blast at the end of the month; Table II, production of steel ingots and castings in June, and Table III deliveries of alloy and non-alloy finished steel now revised. Table IV, also revised, summarises the activities of the steel industry as a whole during the six months ended June, 1946.

TABLE I.—*Production of Pig-iron and Blast-furnace Ferro-alloys (Thousands of tons.)*

District.	Furnaces in blast, 29.6.46	Weekly average production, June, 1946. Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants, and Essex	24	—	16.4	16.0	1.0	—	33.4
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Ches. / Yorkshire (incl. Sheffield, excl. N.E. Coast)	5	—	5.6	—	—	0.6	6.2
Lincolnshire	13	—	21.4	—	—	—	21.4
North-East Coast	26	5.6	30.2	0.4	—	1.8	38.0
Scotland	10	0.6	9.2	2.1	—	—	11.9
Staffs., Shrops., Worcs. and Warwick	8	—	6.2	1.2	—	—	7.4
S. Wales and Monmouthshire	7	2.9	16.5	—	—	—	19.4
North-West Coast	6	13.0	—	—	—	0.8	13.8
Total	99	22.1	105.5	19.7	1.0	3.2	151.5
May, 1946	97	22.2	105.1	20.2	1.0	2.7	151.2
June, 1945	99	20.2	89.9	19.0	1.3	2.6	133.0

TABLE III.—*Deliveries of Alloy and Non-alloy Finished Steel (Thousands of tons.)*

Product.	Weekly average. 1944.	1945.	1945. June.	1946. May.	1946. June.
Non-alloy steel:					
Heavy rails and sleepers	6.5	7.1	7.1	10.9	8.8
Plates	30.8	26.4	28.0	32.8	32.0
Other heavy products	38.2	33.1	37.6	33.4	33.6
Light rolled products (excl. wire rods and alloy steel bars)	46.2	41.9	42.2	53.5	46.9
Ferro-concrete bars	2.1	1.8	2.0	4.1	3.7
Cold rolled strip	4.2	4.0	4.7	4.2	4.0
Bright steel bars	4.9	3.9	4.1	4.8	4.3
Sheets, incl. coated	21.2	20.2	22.8	24.0	22.2
Tin, terne and black plate	10.0	9.5	10.9	10.2	9.3
Tubes and pipes	12.3	10.9	12.0	14.7	13.6
Steel wire	12.2	10.2	11.2	12.5	11.3
Tyres, wheels and axles	2.6	2.5	3.1	3.5	3.6
Forgings	5.9	5.3	6.2	4.9	5.2
Castings	5.1	4.1	5.2	3.0	3.0
Total	202.2	180.9	197.1	216.5	201.5
Alloy steel:					
Plates	1.9	1.1	1.2	0.3	0.3
Tubes and pipes	0.6	0.3	0.4	0.2	0.3
Bars, sheets, strip and wire	5.6	3.0	3.5	3.0	2.7
Forgings	5.0	2.2	2.4	1.5	1.5
Castings	1.7	0.9	1.1	0.6	0.6
Total	14.8	7.5	8.6	5.6	5.4
Total production*	217.0	188.4	205.7	222.1	206.9
Less Intra-industry conversion	24.5	17.8	19.8	18.7	15.1
Total net U.K. deliveries	192.5	170.6	185.9	203.4	191.8
Add Deliveries of imported finished steel	5.0	1.0	0.5	—	—
Total deliveries of finished steel	197.5	171.6	186.4	203.4	191.8

* Includes finished steel produced in the U.K. from imported ingots nd semi-finished steel.

TABLE II.—*Production of Steel Ingots and Castings. (Thousands of tons.)*

District.	Weekly average production, June, 1946. Open-hearth. Acid.	Open-hearth. Basic.	Bessemer.	Electric.	All other.	Total.* Ingots.	Total.* Castings.	Total ingots and castings.
Derby, Leics., Notts., Northants, and Essex	—	—	(Basic) 9.5	0.9	0.3	10.3	0.4	10.7
Lancs. (excl. N.W. coast), Denbigh, Flints. and Ches. / Yorkshire (excl. N.E. Coast and Sheffield)	0.9	18.1	—	0.3	0.3	18.9	0.7	19.6
Lincolnshire	—	24.7	—	—	0.1	24.7	0.1	24.8
North East Coast	2.4	45.4	—	0.5	0.3	47.6	1.0	48.6
Scotland	5.5	29.4	—	0.6	0.6	34.7	1.4	36.1
Staffs., Shrops., Worcs. and Warwick	0.2	13.2	—	0.4	0.5	13.5	0.8	14.3
S. Wales and Monmouthshire	6.0	37.0	(Basic) 4.2	0.6	0.1	47.6	0.3	47.9
Sheffield	7.9	17.7	—	5.0	0.5	29.8	1.3	31.1
North-West Coast	0.1	2.8	(Acid) 3.8	—	—	6.6	0.1	6.7
Total	23.0	188.3	17.5	8.3	2.7	233.7	6.1	239.8
May, 1946	26.6	203.2	19.7	9.3	3.0	254.9	6.9	261.8
June, 1945	26.8	181.3	12.5	11.7	6.0	227.0	11.3	238.3

* Including alloy.

(*Continued at foot of page* 434.)

THE MODERN PIG

IF YOU WANT...
clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify
STANTON MACHINE CAST PIG IRON

SPECIFICATION

WEIGHT	80-90 lbs.
Length	22 inches
Width	8½ inches
Thickness	3¾ inches

(at notch 2½ inches).

Made in our well-known

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THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

NEWS IN BRIEF

THE SWEDISH CONSUMERS' CO-OPERATIVE ASSOCIATION plans the construction of an enamelled-bath factory, with an annual capacity of 175,000 to 200,000 baths. Part of the production is for export.

WE REGRET THAT the well-known trade mark of the Fordath Engineering Company, Limited, "Glyso," was printed as "Glyco" in our last issue in a paragraph dealing with the linseed oil shortage.

TABLE-TENNIS BATS, made of magnesium alloy, are amongst articles likely to appear in the American market. Magnesium face-powder compacts have found a ready sale at $5 each retail. Chicago stores disposed of 40,000.

THE DOMINIONS FOUNDRIES & STEEL, LIMITED, of Hamilton, Ontario, have installed the largest Wheelabrator Turnblast so far made. The drum is 60 by 96 in. and it has cleared 2 tons 6 cwt. of steel castings in 15 mins., using nearly 6 cwt. of abrasive per min.

THOMAS WILKINSON & COMPANY, LIMITED, manufacturers of foundry requisites, etc., of Stockton Street, Middlesbrough, have been merged with William Cumming & Company, Limited. Their materials, however, will continue to be manufactured at their mill at Stillington.

ONE OF SWEDEN'S internationally best-known companies, the Bofors steel and armament works, quite recently celebrated its 300th anniversary with an impressive exhibition, the awarding of medals to 1,200 veterans, and a substantial donation to the employees' welfare funds.

THE MAST-FOOS MANUFACTURING COMPANY, of Springfield, Ohio, are planning to make 70,000 standard, and 12,000 motorised, lawn mowers this year. Through a change over to aluminium for certain components, they are 13 lb. lighter than the pre-war model. They are priced at $16 and $18.

A LARGE SELECTION of good-quality, general-purpose machine tools are on sale at two additional selling centres for Government-owned surplus machine tools opened at the Ministry of Supply Store, Daimler No. 2 Factory, Browns Lane, Coventry, on Tuesday, and the Ministry of Supply Store, Featherstone, yesterday (Wednesday).

MR. ROBERT J. ALLEN and Mr. Hugh Landseer Bailey, of H. Landseer-Bailey, ingot metal manufacturers, Garratt Lane, London, S.W.18, announce that they have sold their entire shares in the Newport Smelting Company, Limited, to the remaining director, Mr. C. H. Matthews, and have severed their connection with that company.

SPEAKING AT MONTREAL Sir Patrick Ashley Cooper, governor of the Hudson's Bay Company and a director of the Bank of England, said that he felt that nationalisation had made little difference to the Bank of England. However, the nearer the British Government got to the problem of nationalising the steel industry, the more they would realise that nationalisation was too complex to be carried out effectively.

THE DEPARTMENT OF APPLIED CHEMISTRY of the Northampton Polytechnic, St. John Street, London, E.C.1, has organised two series of lectures, commencing on October 8 and 10 and continuing weekly thereafter, dealing with fuels and combustion. The first series covers "Combustion and Furnace Practice" and the second "The Occurrence, Production and Properties of Solid Fuel." The fee for either course is a guinea.

METAL INDUSTRIES, LIMITED, have taken over Faslane Port, the £5,000,000 pre-invasion port built by the Government on Gareloch, Clydeside. It is estimated that some 1,500 workers will be assured of work there for at least 20 years. The company have also acquired from the Ministry of Transport a 32,000-ton floating dock, used for the repair of battleships, liners and merchant ships on the Clyde during the war, and several powerful tugs, to operate as a rescue and salvage service for the west coast of Scotland.

EXTENSIONS TO DORMAN, LONG'S STRUCTURAL ENGINEERING SHOPS

The main structural engineering shops of Dorman, Long & Company, Limited, Middlesbrough, are being extended to facilitate the handling and fabrication of the large tonnages of structural steelwork which the company has on order for home and export. The area of the existing shops is being increased by over 110,000 sq. ft. at a cost of some £120,000. The extensions will be equipped with new and up-to-date handling devices to ensure the even flow of material and enable the output of fabricated steel from these shops to be increased by about 20 per cent.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from page* 432.)

TABLE IV. *General Summary of Pig-iron and Steel Industry.* (*Weekly average in thousands of tons.*)

Period.	Iron ore output.	Imported ore consumed.	Output of pig-iron and ferro-alloys.	Scrap used in steel-making.	Steel (incl. alloy). Steel imports.	Steel (incl. alloy). Output of ingots and castings.	Steel (incl. alloy). Deliveries of finished steel.*	Steel stocks held by producers, etc.†
1944	297.6	46.8	129.5	141.7	26.6	233.5	197.5	2,171.0
1945	272.5	77.2	136.7	138.5	2.9	227.3	171.6	1,683.9
1946—January	245.3	96.7	143.6	134.8	5.0	228.8	173.4	1,223.9
February	256.1	99.6	146.1	146.7	9.5	247.2	186.0	1,197.8
March	256.4	108.1	147.3	155.2	5.8	255.7	200.6	1,173.9
April	243.5	111.4‡	148.7	152.4	5.6	252.1	184.6	1,129.6
May	244.9	115.1	151.2	159.1‡	10.6	261.8	203.4	1,146.1‡
June	225.5	118.7	151.5	140.4	9.0	239.8	191.8	1,131.8

* Including alloy. † Stocks at the beginning of the years and months shown. ‡ Revised.

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PROGRESS OF IRON AND STEEL EXPORT TRADE

The appended table has been taken from the Statistical Bulletin for July, issued by the British Iron and Steel Federation. It shows the course of the iron and steel export trade during the first two quarters of the current year, compared with the last quarter of 1945 and the year 1938.

Exports of Iron and Steel (Thousands of tons).

Product.	Year 1938.	Annual rate.		
		1945, 4th quarter.	1946.	
			1st qtr.	2nd qtr.
Alloy steel bar and rods	4.9	8.7	14.2	20.1
Steel bar and rods (non-alloy)	102.0	177.4	261.5	294.1
Angles, shapes and sections	67.4	98.1	152.0	162.5
Girders, beams, joists and pillars	33.5	45.9	95.9	73.1
Steel rails, new	106.0	89.8	214.4	179.1
Sleepers, fishplates and soleplates	25.4	50.9	147.1	91
Tyres, wheels and axles	44.2	28.3	54.8	79
Plates and sheets ¼ in. thick and over	131.0	173.8	318.7	377.4
Sheets under ¼ in. thick	63.5	4.7	19.1	60.2
Tinned plates, terne plates and sheets	329.4	52.3	97.1	128.7
Wrought tubes, pipes and fittings	220.0	140.0	247.1	293.9
Wire (except insulated wire)	55.2	21.5	69.6	87.9
Hoop and strip	37.2	19.3	83.2	84.4
Black plates	14.5	9.6	16.6	43.4
Total of above	1,234·2	920.3	1,791.3	1,975.0
Total iron and steel (including items not included above)	1,959·4	1,169.9	2,303.3	2,682.8
Total value of iron and steel (£000s)	42,746.2	35,360.4	72,648.9	92,004·4
Average value per ton (£)	21.816	30.225	31.541	34.29

SUPPLIES OF RAW MATERIALS

BOARD OF TRADE SURVEY

The supply position of some of the principal raw materials is surveyed in an article published in the "Board of Trade Journal." It states that the nation's reconversion programme has not so far been seriously affected by shortages of iron and steel, but that supplies in the next few months will be very tight in view of the growing demand from consuming industries. Home production has been running at a very high level and is still rising. Substantial tonnages expected from the U.S.A. cannot now be delivered owing to strikes. Supplies from the Continent, which were up to a million tons before the war, are not available in any large quantity. The available supplies are allocated among Government departments which authorise the consumers, for which they are responsible, to place orders with the steel firms. The allocations of steel for export have been drastically reduced from the rate permitted in the first half of the year. The bulk of the exports are for necessary services overseas, such as railways, oil companies, etc., which it is essential to keep going in order that Britain may obtain necessary supplies of raw materials and foodstuffs. Thus all tinplate exports, except a small quantity for the oil companies, go to food-producing countries for canning food to be shipped to the United Kingdom.

For lead, which will be in short supply for probably at least two years, every effort is being made to substitute other materials. Consumption in this country is controlled by a rationing scheme which has the effect, *inter alia*, of reducing exports of semi-manufactures in lead to almost negligible proportions. Exports of manufactured articles requiring lead, particularly cables, are permitted, but must be limited so long as the supply position makes it difficult to meet such basic reconstruction requirements at home as lead for housing, batteries and cables. The other principal metals which are in tight supply or may be in short supply in certain specifications are zinc and copper.

OBSCURITIES OF GOVERNMENT'S STEEL PROPOSALS

EFFECT ON ECONOMIC RECOVERY

Referring to the Government's intention to nationalise a part of the iron and steel industry, Mr. E. H. Lever, chairman and managing director of Richard Thomas & Baldwins, Limited, in his statement accompanying the report and accounts, says that until the intentions of the Government as to the extent and nature of its proposals for State ownership have been more precisely defined, it is impossible to say how far their company will be affected if the Government succeeds in passing the necessary legislation, but, judging from the pronouncement of the Minister of Supply in the House of Commons, their major assets are likely to be involved.

"To press forward a scheme of nationalisation at this moment is likely to strike a serious blow at the country's economic recovery," Mr. Lever continues. At the best, the uncertainty would lead to delay, and to an increase in capital cost which the country could ill afford, and, at the worst, the results might well be disastrous. It was difficult, at this moment, to say how the plans for the erection of new strip mills in Wales which they had, for a long time, been working out in conjunction with other firms, would be affected. The schemes were by their nature complex and delicately balanced, and the Government's decision had had the effect of threatening the foundations on which they were built. Delay in proceeding with the physical work was inevitable, and indeed had already taken place. Clearly the whole plan would have to be re-examined in the light of the altered conditions.

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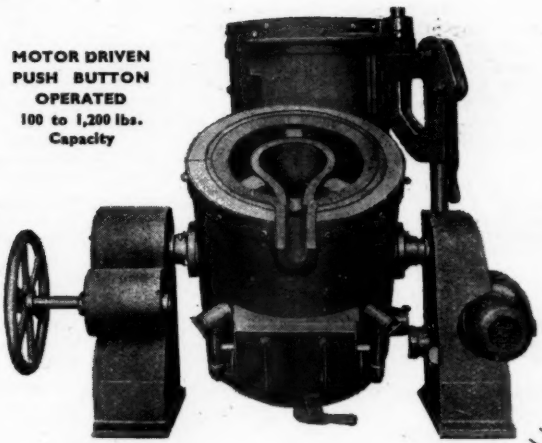

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PERSONAL

MR. J. S. WHYBROW has been appointed a director of the Stirling Boiler Company, Limited, and deputy general manager to Mr. G. Summers, with effect from July 1.

MR. JAMES M'GOWN, who has retired from his position as works manager of Shanks & Company, Limited, engineers and ironfounders, of Barrhead, near Glasgow, started his career with them 58 years ago as an office boy.

MR. J. F. DAWSON, on medical advice, has resigned the managing directorship of G. D. Peters & Company, Limited, of Slough. He will remain as deputy chairman. MR. J. E. BLACKSHAW and MR. R. NEEDHAM have been appointed joint managing directors of the company.

DR. M. L. BECKER has taken up his appointment as superintendent metallurgist to the British Iron and Steel Research Association. Until recently he was chief metallurgist to the gear and tool divisions of David Brown & Sons (Huddersfield), Limited. Previously he was on the staff of the National Physical Laboratory. Earlier in his career he was investigator to the B.C.I.R.A.

MR. A. H. CARMICHAEL, who has been appointed a member of the United Kingdom trade mission which is expected to leave for China about the middle of September to study methods of developing trade between China and the United Kingdom, is the Director of the Brass and Copper Tube Association, and is also a member of the Executive Committees of the British Non-Ferrous Metals Federation and the Non-Ferrous Wrought Metals Export Group. He was engaged in commerce in China for many years.

Will

POCOCK, E. J., a director of the G.K.S. Combustion Company, Limited, Pocock, Chapman & Company, Limited, engineers, boiler makers, etc., Mountstuart Dry Docks, Limited, and Gould's Foundries, Limited £4,484

NEW COMPANIES

("Limited" is understood. Figures indicate capital. Names are of directors unless otherwise stated. Information compiled by Jordan & Sons, 116, Chancery Lane, London, W.C.2.)

Chilmew Engineering Works, 50, Pall Mall, London, S.W.1—£4,000.

White, Bays & White—Engineers, etc. £4,000. T. Wyatt, G. H. and W. White.

Juno Engineering—£2,000. J. and N. Harris, 8, Fountayne Road, London, N.16.

Isaac & Uren (Engineers), Sutton Road, Plymouth—£5,000. J. A. Isaac and R. Uren.

R. G. Horton (Engineers), North Street, Brierley Hill, Staffs—£1,000. R. G. Horton.

Dudley Engineering, 51, Mill Street, Brierley Hill—£1,000. C. P. Homes and E. Nicolson.

Mosda, 47, Frederick Street, Birmingham, 1—Engineers, etc. £10,000. M. and S. L. Davis.

I. Holland—Mechanical engineers, etc. £2,000. I. Holland, 59, Ashfield Avenue, Beeston, Notts.

Har Dall, 83, Cardigan Street, Luton—Engineers, etc. £2,000. L. N. Richardson and T. E. Smalley.

Nealis Harrison, 98, Etherington Road, Hull—Engineers, etc. £2,500. N. C. and M. D. Harrison.

A. Fryer & Sons—Brass casters. £8,000. A. and J. Fryer, 16, Tobruk Road, Portobello, Willenhall.

Bruce Engineering, Flat 27, 37, Grosvenor Square, London, W.1—£10,000. M. M. and A. P. E. Bruce.

Henderson Foundries, Grove Road, Northfleet, Kent—£1,500. R. P. Henderson and W. J. Waghorn.

Metalcraft (Cheltenham), America Passage, Cheltenham—£2,000. W. G. Gunningham and R. W. A. Ward.

Northern Engineering Equipment, 7, Bond Place, Leeds, 1—£6,000. R. A. Sherwood and W. B. Lindley.

A. M. Steele & Son—Engineers, etc. £2,000. A. M. and A. G. E. M. Steele, 28, Carnarvon Avenue, Enfield.

Kent Metal Finishers, Bill Street Garage, Frindsbury, Kent—£3,000. H. Crawshaw and H. J. Mason.

G. Nissel & Company, 6, Highfield Avenue, Pinner—Machinery manufacturers, etc. £1,500. S. M. L. Nissel.

Brighton Electronics, 15, Ship Street, Brighton—£1,000. R. J. Cartwright, A. R. Bradford, and R. G. Nutt.

Argent Bros., Power Works, Slades Green Road, Erith, Kent—Engineers, etc. £5,000. R. H. and K. M. Argent.

Seaboard Steel Company of Great Britain, Chantry Works, Grove Lane, Birmingham—£50,000. J. M. Heyman.

Radco Industries (Engineering), 114, Dock Street, Newport, Mon—£1,000. F. R. Busfield and F. G. Griffiths.

Bertrams (Plant & Equipment)—£10,000. F. B. Lockwood, 15, Wellington Court, London, S.W.1, subscriber.

W. G. Thursfield (Patternmakers), 16, Bilhay Street, West Bromwich—£5,000. W. G. Thursfield and W. T. Robotham.

Mosedale Steels—£2,000. W. M. Holt and P. J. Mosedale, Greenways, Damworth Lane, Shirley, near Birmingham.

Country Engineers, Frogs Hole, Terwick, Rogate, Petersfield, Hants—£4,000. J. F. Ward Tamplin and F. J. Allison.

Trupal Engineering, Trupal Works, Stalker Lees Road, Sheffield, 11. £2,000. E. G., P. D., F. W., and A. Malthouse.

R. W. Anderson & Company (Engineers), 13-14, Dartmouth Street, London, S.W.1—£5,000. R. W. and J. E. Anderson.

Eastern & British Industries, 22, Surrey Street, Strand, London, W.C.2—Engineers, etc. £5,000. C. A. Bolton and B. Kashyap.

Essex Engineering, 32, St. James's Street, London, S.W.1—£1,000. G. E. Hince, R. G. Austin, and T. C. W. Sands.

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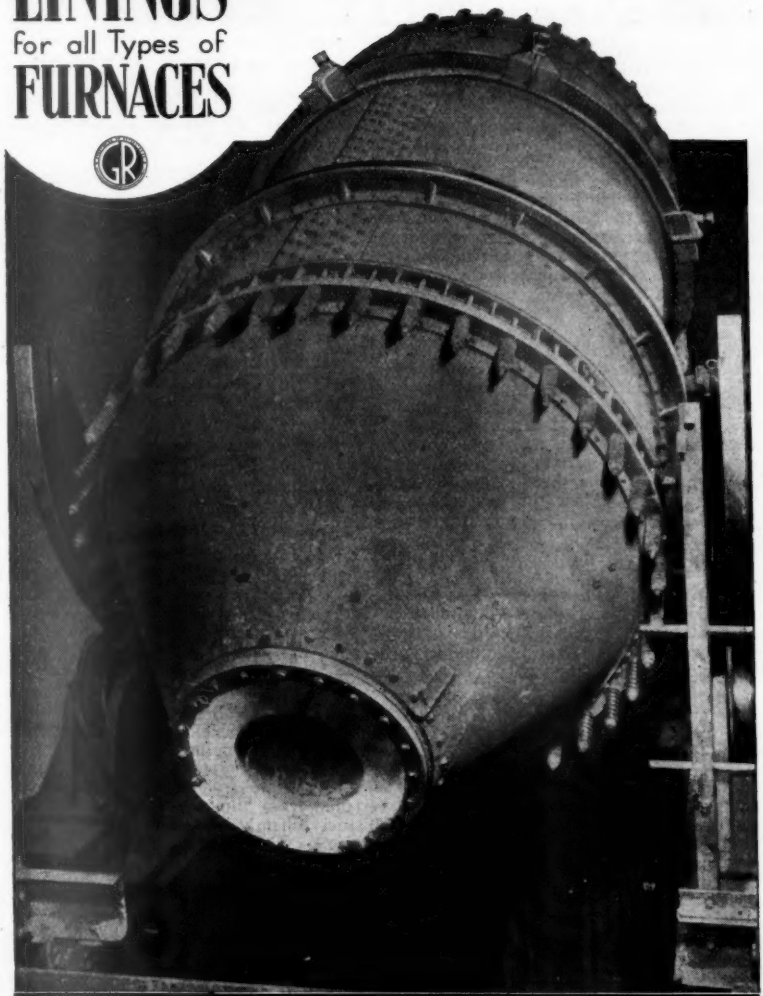

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Raw Material Markets

IRON AND STEEL

The increased prices for iron and steel, announced last week, have been favourably received in the market. Consumers in many cases were prepared for a steeper rise. High-phosphorus pig-iron, which is used extensively by the light-castings trade, is in rather stringent supply and stocks all round are low. Current licences are only about sufficient to cover immediate requirements. The light-castings trade is fully engaged and expansion is inevitable if the housing programme is not to be jeopardised. Supplies of hematite, low- and medium-phosphorus pig-iron and refined iron for the engineering, jobbing and speciality foundries appear to be adequate for current needs, which are now on a very wide scale, as the engineering foundries are more active all round. These foundries also use ferro-alloys, supplies of which are adequate. Cast-iron and steel scrap is coming along reasonably well, but the light foundries continue to have some difficulty in getting all the light and medium cast scrap they require. Limestone and ganister, together with supplies of firebricks, are coming forward satisfactorily.

The demand for semi-finished steel by the re-rolling mills is at a very high level. The sheet makers have sufficient work already on hand for the next six to nine months and most rollers of bars and strip are committed up to the end of the year. Everything possible is being done to step up the supply of home-produced semis.

There is an abundance of orders in hand at the steelworks for joists, sections and plates—far more, in fact, than they can execute this year. The demands from rolling-stock makers, boiler makers, shipbuilders, structural engineers, etc., are very heavy.

NON-FERROUS METALS

It is expected that the Ministry of Supply will announce the new price for Nigerian and Malayan tin in the near future. A desire to arrive at a unified world price structure has been the reason for the delay in renewing the contract with Nigerian producers and of fixing a price for the forthcoming Malayan output. The U.S. Government is understood to have reached agreement with the Bolivian mine-owners regarding tin purchases. Thus the way would now seem to be clear for a price announcement by the Ministry of Supply, as the British Government is known to have been delaying its decision pending publication of the Bolivian terms.

Strikes at Rhodesian mines are reported to have resulted in a loss of production of some 18,000 to 20,000 long tons of copper monthly. The dispute now seems to be approaching a settlement, but it will affect British consumers unless there is an early resumption of work at the mines, or, alternatively, the Ministry of Supply can arrange for adequate supplies from other sources, which is highly improbable. U.S. copper production in July showed a moderate recovery.

NEW PATENTS

The following list of Patent Specifications accepted has been taken from the "Official Journal (Patents)." Printed copies of the full Specifications are obtainable from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

577,133 HATFIELD, W. H., and BRIDGE, J. F. Process for improving the properties of iron alloy castings.

577,170 COOK, M., ALEXANDER, W. O., and IMPERIAL CHEMICAL INDUSTRIES, LIMITED. Hard copper alloys.

577,197 LOEWY ENGINEERING COMPANY, LIMITED, and SALTER, F. S. Retractable work support for metal-forming machines.

577,235 TOOL & STEEL PRODUCTS, LIMITED, FROLICH, H., and ELLIOTT, B. Adjustable drawing dies.

577,237 MILLSPAUGH, W. H. Centrifugal metal-casting machines.

577,249 PLASCO, LIMITED. Method of producing dies by powdered metallurgy.

577,255 NEUSTADTER, D. Stoves for drying foundry moulds and cores.

577,264 FIFE, J. G. (Meehanite Metal Corporation). Apparatus for supplying air to furnaces.

577,272 LINDEMUTH, L. B. Ingot moulds.

577,281 SOC. ANON. DES MANUFACTURES DES GLACES ET PRODUITS CHIMIQUES DE SAINT-GOBAIN, CHAUNY ET CIREY, and ORY, G. C. Process of desulphurising iron pyrites ash.

577,289 MOND NICKEL COMPANY, LIMITED. Cast-iron grit.

MR. THOMAS BAKER, owner of the Anglo Iron Foundry, South Shields, which he started in 1920, is to retire, and the foundry is being sold.

MR. T. W. EDWARDS, assistant managing director of the Park Gate Iron & Steel Company, Limited, has resigned from the presidency of the Rotherham and District Chamber of Commerce after seven years' service.

MR. J. C. MILLS, who has for many years been a director of the Zinc Alloy Rust-Proofing Company, Limited, and co-manager of their works in Shakespeare Street, Wolverhampton, has left the service of the company. His place as manager of the works will be taken by MR. S. PERCIVAL, who has been with the company for many years.

MR. D. C. G. LEES, M.A., who has for the past six years been an investigator with the British Non-Ferrous Metals Research Association, has been appointed a technical editor of our associate journal *Metal Treatment*. His Paper on "The Hot-tearing Tendencies of Aluminium Casting Alloys" will be discussed at the autumn meeting of the Institute of Metals.